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NEW YORK, SATURDAY, OCTOBER 6, 1906.

CONTENTS.

Editorial 629
Routine Work of Technical Societies 634
Relation of Cities to Franchises 634
Educating the Salesman by Experience on the Appliances 634
September Meeting of American Institute of Electrical Engineers 635
The Expansion of the Telephone Industry 636
The First Public Telharmonic Concert 637
German Electrical and Machinery Industry 637
Illuminating Engineering Society 638
Current News and Notes 638
Power Plant of the Lackawanna Light Company, Scranton, Pa 641
The Lighting of Churches. By J. R. Cravath and V. R. Lansingh 644
Abnormal Operating Conditions of Electrical Apparatus. By A. E. Buchenberg 647
Papers and Discussions at the Illinois Electrical Convention 649
Papers and Discussions at the Colorado Convention 650
Adjuncts to the Power Load 653
Central Station Works at Franklin, N. H 656
The Burning of Cheap Fuel 656
The Burning of Washer Slate and Coke Braize. By C. G. Atwater 659
Feed Water Heating. Ry R. T. Strohm 661
Letters on Practical Subjects 663
Questions and Answers 669
Organization and Conduct of a Business Department Suitable for Central Stations in Cities of 50,000 Population 670
An Electric Flatiron Campaign in a New England Community of 26,250 Inhabitants. By J. E. Davidson 670
Relation of the Alternating-Current Motor to Central Station Business 672
Flatirons at Grinnell, Iowa 674
Advertising that Catches the Eye 674
Illuminating a Central Station Show Window 674
An Unusual Residence Rate System at Tyler, Texas 675
LETTER TO THE EDITORS:
Low vs. High-Voltage Lamps. By John Roberts 675
Digest of Current Electrical Literature 675
Book Review 679
D'Arsonval Type Ammeters and Voltmeters 679
Gas-Engine Driven Electric Generating Units for Traction Purposes 679
Electrose High-Tension Insulators 680
The Inverted Bowl Reflector 680
Storage Battery Plates 681
Submarine Cable Laying In the Ohio River for Light and Power 682
Artistic Electric Portables 682
Development of Water Wheel Governors 683
Show Window Lighting 683
The Temple-Ingersoll Electric Air Drill 684
Bus Bar Insulator 684
Industrial and Commercial News 685
General News 689
Directory of Electrical Associations, Societies, etc 695
Weekly Record of Electrical Patents 696

THE WIRELESS CONFERENCE.

This week the conference of nations as to regulation of wireless telegraphy is in session at Berlin. Our readers have already been put in possession of the main facts in regard to it, and may have noted the suggestions made in these pages as to feasible methods of reaching a common agreement that will promote the art and not impose burdens on it. No fewer than thirty-one governments are understood to be participants in the congress, and in view of the undeniable importance of the system for naval and military purposes, it will indeed be strange and fortunate if commerce is not hereafter hampered by the new restrictions that so many interested authorities will naturally seek to impose.

It has, indeed, been officially stated that Germany, which initiated the wireless conference idea two or three years ago, will propose that an international bureau shall be created for the control of wireless telegraphy; that each wireless station must be connected with the ordinary telegraphs by special lines; that the conditions under which wireless stations of companies that do not subscribe to the conclusions of the conference shall work, shall be laid down by the conference (that is, when these stations are within the territories of States adhering to the conclusions of the conference); that governments which do not adhere to the convention may do so later, and that when controversies arise over the interpretation or application of the convention they shall be submitted to arbitration. The interest of Germany in the matter seems due not only to its governmental necessities, but to the fact that the wireless systems of the empire have not yet been able to compel other systems to make an interchange of business, i. e., receive messages at wireless stations from ships equipped with the German apparatus. A very pretty quarrel is thus involved, with aspects that are far beyond a parochial effect in the decisions that may now be reached.

Meantime, advices from Ghent, Belgium, state that the Institute of International Law has been holding its annual meeting there when several articles relative to wireless telegraphy were voted. It was held that the regulations governing wireless telegraphy in time of peace are applicable in principle in time of war. Belligerents may prevent the transmission of Hertzian waves by a neutral state over the high seas within the sphere of their military operations. All persons taken prisoners while receiving or transmitting wireless messages from belligerent territory or between different sections of a belligerent army are not to be considered spies, but are to be treated as prisoners of war, unless their operations were carried on under false pretenses. Carriers of dispatches received by wireless who make use of concealment or ruse in their work are to be regarded as spies. Neutral ships and balloons proved to have been used to furnish an adversary with information helpful in the conduct of hostilities may be removed from the zone of hostilities and the wireless apparatus on board may be seized and sequestrated. A neutral state is not obliged to prevent the passage across its territory of Hertzian waves destined to a country at war. A neutral state has the right to close or take over the wireless

telegraphy station of a belligerent operated in its territory. Every prohibition in the matter of wireless communication made by belligerents must at once be communicated to neutral governments. It will be seen that all this deals with questions of warfare. What the United States is far more interested in are the questions of peace.

Legislative Influence on Meter Inspection.

In the dim and distant early days of electric lighting some twenty years ago almost the only meters employed on distribution circuits were electrochemical. The early electrochemical meter has now nearly disappeared. It possessed, however, a number of advantages. It was simple and crude in construction, inexpensive and of very small power consumption. Only by oversight or mistake could it overindicate or overcharge the customer. The only delicate portion of the apparatus—the electrolytic cells—were renewed each month. It had the defect of distinctly underindicating at light loads; but its fatal defect was that the customer could not read its indications. To the public mind there was something wrong with a system of metering in which the record had to be carried away each month to the central station, there to be evaluated into dollars and cents by experts with chemical balances and mystic artifices. It was not the fear of unfairness, so much as the infringement of the dogma of taxation without representation, which haunted the public mind. Satisfaction was reached only by the use of a dial-indicating or registering meter. The experience with electric indicating meters has been the same as that with gas meters. Probably not one consumer in one hundred keeps tally of the record on his gas meter; but he is content in the belief that he could if he would, and that the inspector who makes monthly visits to the meter will be deterred from making mistakes by the possibility of the customer's latent capacity for verification. This is, of course, very natural, but it is also a curious mental trait of the average individual.

The dial reading of a watt-hour meter is not a lucidly apparent thing to those who are familiar with the subject matter, but who are not in the daily practice of meter reading. That is to say, a meter inspector by practice and training can often write down the record of a consumer's meter dial with ease and security in the dim religious light of a city cellar; but the average electrical man, not specially trained in the performance, does not feel quite satisfied with his guess at the reading unless he has brought a strong light to bear upon the dial and has conned it over several times like an entry in a railway time table. The average householder is quite as well qualified to read a meter as an electrical man not specially trained; but he is more likely to be puzzled by the terms printed on the dial, and to distrust his interpretation even with the best light and convenience in the inspection, so that it is very rarely that a customer reads his own electric meter. Nevertheless, the public mind is content, because the record is readable at all times to whom it may concern. In rare cases disputes occur as to bills for electric supply that the customer thinks have been excessive. In some of these instances the accuracy of the meter is impugned. A question of fact of this nature is, of course, readily capable of being determined by tests or by comparison with a standard meter, so that central station managers rarely fail to satisfy reasonable criticisms. Nevertheless, suggestions occasionally appear for legislative interference with the business of electric energy metering. Various municipalities have already passed ordinances on the matter.

It is important that the electric lighting industry should endeavor to secure wise and just legislation on this question whenever legislation becomes necessary. Unwise or ill-considered legislation, enacted perhaps for the supposed protection of consumers, may not only hamper the central station unnecessarily, but may also act detrimentally to the interests of the consumer. For instance, in Canada there exist laws which require all meters to be tested and sealed by a State inspector before being installed. Access to the interior of the meter is thereafter denied to all parties unless the meter is retested and resealed by the State inspector. Such a method of procedure, while it looks fair at first sight, is liable to injure all interests. All meters require to be tested periodically and readjusted to accuracy, since in practice they tend to run slow in time. The Canadian type of legislation prevents the central station from checking a meter *in situ*, and hampers it otherwise, thus tending to diminish the precision of service. In its turn this must tend away from the reduction of the selling price of electric energy. It is far better to arrange for having meters tested on demand in case of disputes on their accuracy.

Burning Cheap Fuel.

Elsewhere in this issue appear several articles on the burning of cheap fuel, which is a subject that has been too long neglected by central stations. Coal accounts for a very large percentage of the total costs of an electric light station, and none of the items which make up the total cost of production, with the exception of coal, is capable of being materially reduced, so that aside from this item reduction can only be brought about by increased output. A central station is conducted on a money basis, and the main problem which confronts the engineer is how to deliver a unit of electricity at the bus-bars with a minimum consumption of coal, the solution of which is most likely to give the best returns for the time expended on it. With the layout of a station the engineer has oftentimes little or nothing to do. It is presumed that all the conditions were carefully considered when the plant was decided on, so that all that is left to the engineer is to work the equipment in the most economical manner and to introduce only such improvements and modifications as will give a reasonable return on the capital outlay. Each station furnishes a separate problem, and the measure of success is indicated in the net saving in the coal bill at the end of the year. It is regrettable, however, that where economy should commence it is often unknown. The fact that the loss in the production of steam cannot be possibly recouped at any later stage in the process of generating electricity, is seldom, if ever, recognized. Even though supplied with very economical engines, there may be great opportunities for saving back of the stop valve.

The articles published so far on the burning of fuel show that the utilization of low-grade fuel does materially reduce the cost of steam production, and therefore the cost of generating a unit of electricity. In addition they also show how such low-grade and cheap fuel may best be utilized for steam production. That a cheap class of fuel can be used is no reason, however, why it should be wasted; and it is often because of such waste that lack of economical results prevails in many boiler rooms. This is especially true of small stations, which by reason of their size and location, cannot have the benefit of expert supervision and attendance. A bad load factor has much to do with this condition of affairs, as the fuel required for banking

fires and keeping steam up to a reasonable pressure, is out of all proportion to the output. Load factor affects the boiler room more than the engine room. A standing engine does not waste fuel; but the radiation loss from boilers is constant, and the ratio of this loss to the heat put in is greatest when the fires are banked or when the boiler pressure is only half what it is normally. If high efficiencies are to be obtained by burning cheap fuels, it is important that the furnace must suit the fuel. Experience shows that the higher the furnace temperature the greater is the efficiency of the transmitting medium, from which it follows that the greater is the evaporative power of the boiler and the greater its efficiency. Reverberatory arches of fire brick above the fire have been successfully employed for attaining exceedingly high temperatures in boiler furnaces; but there is a limit beyond which it is not safe to go. With furnaces of this description it is possible to drive a fire which no brick can withstand, and in attempting too much the water is caused to pass over bodily from the boiler into the pipe lines at the expense of efficiency. With well-designed boilers, flues, chimneys and accessories it is possible to burn the cheapest grades of fuel with material saving in cost. Having provided these the only one who can effect economy is the man who actually burns the coal. A fireman has little incentive to economy except that he knows that the less coal that he throws on the fire, the less manual labor he has to perform, and so long as he keeps a steady head of steam no fault is found with him. Thus far the frailty of human nature works on the side of economy; beyond this an inducement may be offered in the shape of a bonus or increase in salary dependent on the amount of coal saved. This has been done with profit in some stations.

The Motor Bus Abroad.

Those who are weary of seeing rickety omnibuses dragged by spavined bags of bones that once were horses may be interested to know of the progress made abroad by motor-driven public vehicles. In London alone a million and a half passengers are carried each week in such buses, of which now nearly a thousand are already in use, and eight hundred more are under construction by a single company. These vehicles are for the most part regular gasoline machines and make each a daily run averaging 100 to 120 miles. Somewhat noisy they are, and more or less subject to accident, but these figures show very plainly that from now on they must be seriously reckoned with in considering rapid transit facilities. Running as they do in well-established routes and making the daily mileage of an electric car, they should, as they do, pick up a considerable passenger traffic. Of course, conditions in London are unique, and no American city presents quite parallel conditions, yet the results reached there ought to prove encouraging to those interested in public motor vehicles here. In American cities most of the attempts at such service have been largely in the nature of cab service, largely by electric vehicles. Extremely unsuccessful at first, the dearly bought lessons of experience have been mastered and the business is looking up here as abroad. The motor bus, however, has a good many practical advantages over the motor cab, and we hope the efforts to build up such service in this country will meet with success.

The motor bus has the merit of furnishing an auxiliary rapid transit intermediate between ordinary cab service and that given by a tramway. The bus is not confined to a track or to any definite route except that prescribed by convenience, and with a speed not greatly less than that of a tramcar, can be pressed into whatever districts need it most. The bus itself costs in proportion to its seating capacity much less than a cab, and can afford to carry passengers at a moderate fare. It would be interesting to know whether the double-decked London motor bus could be acclimated in New York and elsewhere in this country. The tendency here has thus far been toward the very capacious gasoline-electric machine approximating a medium-sized tramcar in capacity, and as compared to the London type, rather unwieldy. In fact, the acute necessity for complete control in these heavy cars has been the motive for the electric connecting gear. There seems to be little chance for straight storage battery vehicles on this large scale, although they have been doing much better than was to be expected. Electric vehicles of the lesser sort are doing well and are on the increase, but for the rough-and-tumble work of a public city line there is much to be said for the London plan. A bus of moderate weight and length can be managed in a crowded street with far more facility than a larger type, and while costing a little more per seat, can probably make enough better daily mileage to compensate for the difference. Whether the pure mechanical drive will do better than the gasoline-electric combination remains to be seen. Under favorable conditions the former has some advantage in efficiency and a large advantage in first cost. Yet after protracted service, wear and tear, always considerable, tells heavily against the mechanical drive, while the electric one as a whole is likely to be in good condition. However this may turn out, it looks as if the motor bus was in the game to stay. Anything that facilitates rapid transit is welcome.

16 C. P. Out of Date.

When the incandescent lamp approached the commercial stage, the fixing of a standard candle-power was naturally a matter of great moment. In Great Britain it was thought best to fix the standard at 10 candle-power, apparently on the theory that, owing to the flexibility of electrical distribution, consumers to approach ideal artificial illumination would prefer that the sources of light be distributed, and for this purpose they should be of low candle-power. Edison, on the other hand, viewed this question from the standpoint of gas competition and fixed the candle-power at that of the 5-cu. ft. gas jet of the day. At the present day neither of the above considerations retains any weight, if indeed the first-mentioned ever received any practical confirmation. It is true that when seeking for artistic effect, lamps of small candle-power can sometimes be effectively used. In large interiors, however, great arrays of even 16-cp lamps become unsightly—sometimes offensively so—and the best effect may call for units of comparatively high candle-power. In the case of residences, and particularly small residences, experience has indicated that the number of outlets is almost invariably fixed by practical considerations which cannot be subordinated to the exigencies of ideal distribution of sources. This latter remark applies to all but a negligible percentage of lighting in small cities and towns, and also to the greater part of lighting in the largest cities. In fact, the conditions are such that illuminating engineering is becoming an important part, not so much because of what its practiciens can accomplish with respect to the design of illumination along ideal lines, as in getting the best results that conditions everywhere conflicting with the ideal will allow.

As to candle-power in relation to gas competition, the 16-cp unit is now hopelessly out of date and is a serious and increasing handicap to electric lighting. At present the standard gas jet is of 22 cp, and the Welsbach mantle is rated at 20 cp per cubic

foot of gas per hour, or 60 cp for the standard mantle. The expression "red hot hair-pin," as applied invidiously to the incandescent lamp, takes on a verisimilitude when one observes an incandescent lamp in proximity to a Welsbach lamp. But it is not a matter merely of unfavorable comparison—the 16-cp unit is at the present day, in most cases, actually too small for satisfactory results under the practical conditions which fix the disposition outlets. In residence, for example, doors, windows, etc., and the location of furniture determine sharply the outlet layout, and, moreover, the relatively small dimensions of the spaces to be lighted do not demand a large number of outlets on the score of satisfactory light distribution. In an ordinary dining-room a central chandelier should provide sufficient illumination, and bright illumination for such a room about 15 ft. square is furnished by three new Welsbachs, the equivalent of which would be perhaps 7 incandescents—a number of sources not called for by any principles of illumination. Again, a room of the same size with three single lamp brackets is insufficiently lighted for many purposes by that number of 16-cp incandescents, and it is unreasonable to require more outlets, or a reserve of lamps, for a case that can adequately be met by the use of lamps of higher candle-power. Similarly, in offices with high ceilings we frequently see a central fixture with four to six incandescents when a single lamp of the aggregate candle-power would be more sightly and introduce practically no change in the light distribution. Lamp manufacturers have recently given attention to the part that the lamp bulb itself plays in illumination; and the coming of the high-intensity metallic filament will probably result in further improvements in this line which, in conjunction with the rapidly growing development in the design of globes and shades, should remove every reasonable objection to the ordinary use of sources of artificial light of a candle-power higher than 16.

In the days of our great-grandfathers the pair of candles on the mantelpiece or the single one on the table, gave the quantity of artificial illumination for ages considered entirely satisfactory. Then came the plain kerosene burner, which reduced the units to one, to be displaced later by the single argand burner. Next the advent of gas with its accompaniment of several outlets to a room, still further lifted the gloom, and the electric light ushered in the present era of brightness. In this genesis of artificial illumination two points stand out: First, that none of the illuminants was displaced by the later comer because of any pressing human necessity for a higher illumination; a fraction of a foot-candle is sufficient for reading newspaper print, and the light of a candle will guide one's footsteps. And, second, each new artificial source was more expensive in service than its predecessor. The fact is, the only criterion for quantity of illumination is daylight. One may to-day fix according to the best existing practice the illumination in foot-candles for various purposes, but in time the data will be out of date, perhaps becoming almost as much so as similar candle-light data would be to-day. The margin for increase in illumination will exist until that of bright daylight is reached, and yearly this margin will be encroached upon. This condition of progression cannot be met by merely increasing for a given space the number of units of the magnitude fixed in the days of dim light; an increase in the candle-power of the standard unit is also necessary. The example set by public lighting—the lighting of main streets, of windows, stores, hotels, etc.—is a powerful stimulus to the inherent desire for an artificial illumination everywhere which approaches daylight. The advance in the brilliancy of this class of lighting has grown enormously in the past few years, but its effect with respect to house lighting has been minimized by the universality of the 16-cp lamp unit. The introduction of the metallic filament lamp, which probably will occur within the next twelvemonth, will provide an ideal opportunity to raise the candle-power; for aside from the considerations above presented will be a powerful commercial one. With a consumption of one-third of that of the carbon filament lamp, which consumption, moreover, gives promise of declining to one-fourth, the tungsten lamp will bring with it a crisis for the central stations. The means to meet this crisis seems to us to be clearly indicated: The craving for brighter artificial illumination is far from being satisfied, the present electrical incandescent lamp unit is too small, and the new lamp when placed on the market should be of a candle-power not less than 25—perhaps as high as 40.

Concentration in Advertising.

The paper by Mr. W. Randolph Sweany, of which an abstract is printed elsewhere in this issue, contains the following sentence in regard to central station advertising which should be thoroughly drilled into the minds of some engaged in writing central station advertising copy: "It is best not to be too general in advertising; drive one thing at a time." Mr. Sweany is practicing what he preaches with excellent results in connection with his work as contract agent of the Minneapolis General Electric Company. Each advertisement is worded to drive home a certain idea and one only. Furthermore, most of the advertising for a certain period is directed at some one subject. One thing at a time is the rule. Probably more central station advertising money is wasted in trying to advertise a lot of things in one advertisement than in any other way. When a salesman goes out to sell goods he does not try to present at once all the things manufactured or dealt in by his house. He would not sell much if he did. Neither can a general advertisement of "electric light, heat and power" be expected to set possible customers to thinking. The rule should be to present one thing at a time; state its advantages clearly and forcibly and change copy often enough to cover the whole list of important applications of central station service within a reasonable time.

Abnormal Operating Conditions of Electrical Apparatus.

In an article which appears in this issue Mr. A. E. Buchenberg gives an interesting discussion of the effects to be observed when electrical machines are operated under conditions different from those for which they were designed. It cannot be denied that when machines have been properly designed for certain conditions the performance may be somewhat less satisfactory when they are compelled to operate under other conditions, and it is desirable that the effects of the various changes be properly appreciated by persons who are interested in the operation of such machinery. The outline given by Mr. Buchenberg is valuable in drawing attention to the direction in which the losses in electrical apparatus may be expected to vary as the frequency or voltage is changed.

The actual values given in the article, however, must be greatly modified if they are to represent results with commercial equipments. Thus in discussing the performance of transformers it is intimated that the losses vary to a large extent with a change in frequency, while as a matter of fact many transformers are designed for operation at either 60 cycles or 133 cycles, and no difference is made in the ratings for the two frequencies. The

eddy-current loss in a transformer is independent of the frequency if the voltage is kept constant, while the hysteresis loss varies only slightly. Thus the total core loss at 133 cycles is only 25 per cent less than that at 60 cycles, while the increase in total core loss due to a change in frequency from 60 to 40 cycles is only 22 per cent. It may be shown that if the total core loss is considered as due wholly to hysteresis the capacity of a certain transformer varies as the three-eighth power of the frequency. The presence of the eddy-current loss causes the variation to be less than the value stated. It may be shown also that even a very large variation in the value of the exciting current considered separately from the core loss, produces a negligible effect upon the operating efficiency of transformers, and an almost negligible effect upon the efficiency of an induction motor.

A Big Transmission Project.

The foreign papers have recently been making no little mention of a rather startling project for the supply of electric energy to Paris from a point on the Rhone, more than 250 miles away. One of the most striking features of the growth of electric power transmission is the way in which hydraulic possibilities come to light even in countries densely populated and of which the resources may seem to be thoroughly well known. The hydraulic works, impracticable at first sight, on account of the lack of a large and profitable market, become available immediately the opportunities of electrical transmission are grasped. In the present instance the hydraulic project is of considerable magnitude. Its scene is the valley of the Rhone shortly after that stream emerges from Swiss territory. Here in a distance of some 14 miles as the river flows through its gorge there is a fall of a little over 200 ft. The normal flow of the stream at low water would here give some 80,000 hp, but for 300 days in the year twice this amount would be available, and as the hydraulic scheme is worked out it includes a storage dam 110 ft. in height to give an artificial reservoir. Of course, there is also storage due to the hydraulic works in the vicinity of the Lake of Geneva, so that there is a fair chance of utilizing considerably more than the minimum flow referred to. The water is to be diverted above the storage dam into two tunnels taking a short cut across country to the power house at Monthoux. At this point it is proposed to excavate space for the power station in the side of the gorge so that the tail races will discharge directly into the stream.

So far the project looks straightforward, although decidedly expensive. It is in the electrical project that the most striking peculiarities appear. The present plan in brief is to use the constant direct-current system, pushing the voltage up to an extreme of 120,000 volts at full load. At ordinary load factors the voltage on the line would be proportionately less, and the working strain on the insulators is intended to be further reduced by putting the middle point of the series to earth at each end of the line, so that the actual potential to earth would not exceed 60,000 volts and would generally be perhaps 10,000 volts lower. This device brings the actual insulation problem within the limits of experience. The station equipment necessary to secure the extreme voltage of 120,000 in direct current is, however, of a formidable character. It is proposed to install in series no less than 48 generators, each giving 1,000 amp. at a maximum of 2,500 volts. It is characteristic of the constant-current system that it shifts the most forbidding difficulties without escaping them, from the line to the station. It avoids extreme and desperate measures in insulating the conductors and courts them in insulating the machines. In this instance the first serious point is the very large current demanded from the high-voltage generators. The proposed output of 2,500 kw per machine at 2,500 volts is several times larger than has yet been secured in a machine of such voltage, and in spite of recent improvements in the matter of sparking, such as have been brought about by interpole design, it seems to us very questionable whether even M. Thury could safely guarantee the performance of such a unit. To operate 48 of them in series and maintain the insulation required is a very serious matter. Fortunately, they can be driven by 10,000-hp turbine units each operating three generators, so that the hydraulic complication is less terrific than the electrical. At the receiving end of the line there must be a corresponding series of motor generators, in all say 144, 2,500-kw machines for a transmission of 110,000 kw.

In ordinary alternating-current practice one would use about 10 or 12 generators in the power house and as many transformers at each end of the line. There is no experience, however, with alternating voltage as great as 120,000 volts, and while the voltage to earth could and would be reduced by the grounding of the neutral point, the insulation problem would still be serious. Nor could one well operate a three-phase system through two conductors and ground in a way corresponding to that proposed in this direct-current case. The 48 generators are in two groups, and the mid-point being grounded, it is planned to work as a ground return system at half voltage if necessary, or even to use this expedient regularly at times of light load to permit inspection and repair of one of the lines. Altogether the scheme is a most daring one. It furnishes sufficient evidence that the constant-current system of transmission is very far from dead, that it should be even tentatively chosen for so colossal a proposition. M. Thury has stuck consistently to it year in and year out, and certainly has been able to install some large and successful plants in spite of the prophets of evil. He is certainly in position to know what can be done—the real question being whether in a given case it is best done in his way. Alternating-current transmission has halted for some time at 60,000 volts; indeed we believe it is only within the present year that any plant has actually reached that full figure in regular working. Transformers have been built and shipped adapted to 80,000 volts and more, but they have had connections for use at lower voltage and there is no sign yet of intent to use them for the present at the higher figure; whereas there is no reasonable doubt that the voltage proposed in this Monthoux-Paris scheme can be successfully insulated so far as the line is concerned. The scheme as a whole, however, seems to be at present somewhat visionary. The proposal to supply energy by any sort of transmission system on the secondary bus-bars at 0.6 to 0.8 cent per kw-hour savors rather too much of the gilded prospectus to inspire confidence. One does not venture to call it impossible, but it would be flattery to call it conservative, if depreciation be taken into account, and the load factor be taken at any probable figure. These mighty power schemes require for successful results combinations of capital and existing plants which are enormously difficult to make. If one would start *de novo* with a great city for a market, electricity could indeed be furnished at a figure that would defy competition. When, however, the urban plants already stagger under the capitalization of all the mistakes since the beginning of the art they are difficult to lure into any practical form of combination.

Routine Work of Technical Societies.

In his recent inaugural address before the American Institute of Electrical Engineers, President Samuel Sheldon gave an account of the routine of the secretary's office of that organization, which is interesting as indicating the vast amount of work necessary to keep a progressive technical society in efficient condition, and the importance of the duties of the secretary.

Because of his familiarity with all phases of the work, the secretary is being constantly called into conference with the officers and members of committees over questions of policy, ways and means. He receives many calls from members visiting New York, and is often able to assist and give valuable advice and introductions in furtherance of professional purposes. This is especially true in the case of members coming from foreign countries. In carrying on his work, except that which he is, by the constitution, required himself to perform, he has the assistance of a staff of six assistants besides an editor and a bookkeeper.

During the Institute year ending May 1, 1906, there were 9,802 letters received and more than 4,000 written. There were 2,760 changes of address made in the catalogue, directory, mailing list and card index. This indicates that the addresses of more than 70 per cent of the members were changed during the year. The number of bills rendered was 5,928, items of remittances received, 4,858; bills received and checked, 825; checks and warrants drawn, 338.

There were 572 applications for election received, and in connection therewith 1,716 endorsement forms were issued, of which 1,638 were returned. The number of applicants for transfer was 53, involving the forwarding and return of more than 600 inquiry forms for the consideration of the Board of Examiners.

Seven editions of monthly announcements, aggregating 96 pages, were prepared and distributed. Numerous notices and circular letters were prepared, printed and distributed to the membership. These related to a variety of subjects such as Institute meetings, convention, proposed revision of the constitution, proposed law regarding the metric system, invitations to visit Europe from our sister societies in England and Italy.

The number of pages of engineering papers and discussions edited and proofread for publication in the *Transactions* was 1,138. In addition to the above-mentioned engineering papers, there were about 250 pages of current Institute news prepared and published in the monthly *Proceedings*, and not included in the *Transactions*. More than 54,000 copies of the Institute *Proceedings* were mailed, 60,250 advance copies of engineering papers were printed and distributed. The cost of the year's work, for the *Transactions*, salaries, postage, express, stationery, printing, etc., was $40,767.22, or $10.48 per member.

Relations of Cities to Franchises.

At the meeting in Chicago last week of the League of American Municipalities, Harry P. Nichols, assistant engineer in charge of the Bureau of Franchises, New York, spoke on "Franchise Conditions in the City of New York." He expressed the view that a maximum rate should be fixed by the terms of the franchise; that the compensation for a franchise should be an initial sum upon obtaining the franchise and an annual sum based preferably upon a percentage of the gross receipts with fixed minimums, and that franchises should be so drawn that the largest measure of control should be reserved to the local authorities.

John H. Head, of Boston, former president of the league, in discussing Mr. Nichols' paper, said: "No license should be given by any city unless it reserved the right to purchase any property so licensed after giving fair warning and at a fair face value of the same."

Mayor Coatsworth, of Toronto, was unable to be present, but his paper on "The Municipalization of Street Railways in Toronto" was read by another delegate.

"It may be roughly estimated," wrote the mayor, "that the situation between the city and the company is that of landlord and tenant. The city has leased out for thirty years from 1891 to the company the exclusive right for the street railway traffic in Toronto on terms and conditions specified, and the charter is not necessarily renewable.

"The provision is that the company shall pay to the city yearly $800 per mile of single track and $1,600 per mile of double track, and also a percentage of the gross receipts. The growth of revenue has been steady, the percentage every year mounting up. There have been many disputes with the company, and eighty-four lawsuits instituted on one side. But the disputes and difficulties did not prevent the city from securing from the company good service."

At the session of the League on September 28, the closing day, it declined to put itself on record as being "for or against" the municipal ownership of public utilities. A resolution by Mayor G. W. McCaskrin, of Rock Island, Ill., and another by Alderman W. Stearns, of Adrian, Mich., demanding a vote on the question by the delegates was killed in the Committee on Resolutions.

This action was followed on the part of the delegates by the tabling of the report of the Committee on Constitution and By-laws, which recommended that the constitution be changed to read: "This organization shall not be committed on the question of municipal ownership of public utilities, nor be used for the furtherance of any particular feature of municipal government."

Mayor Edward F. Dunne was elected president of the League.

Educating the Salesman by Experience with Appliances.

It is a well-recognized fact that a pleased customer is one of the best advertisements that any goods can secure. In the electrical field a very large amount of new business has been won, or kept away, by the attitude of those employing electrical energy and the concomitant apparatus. A development of the idea comes from a well-known central station man, who suggests that the salesmen of apparatus and electricity can themselves be made more enthusiastic advocates if permitted to enjoy greater familiarity with that which they are recommending to other people. The suggestion is well brought out in the accompanying paragraphs from this expert's remarks on the subject:

The other day it occurred to me that the most help toward getting business really came from existing customers who recommended electricity to their friends, and I wondered how many of our own agents came under this head. Of course I do not expect a $7 a week office boy to pay $8 a week for electricity, but on looking the matter up I found that only a small proportion of my agents were customers. Some companies I know give a special discount to employes, but we do not consider this right and no such special discount is allowed here.

It is interesting to note that the highest paid men in the department are those who are using electricity and using it in many ways, i. e., for cooking, flatirons, etc., etc., while some of the men who have been with us a long time, who have not been quite so successful as I should have thought they would have been, are the men who are not using electricity at all.

Of course, sometimes a small salary is the cause of a man's not using electricity, but I think that in more cases it is the effect of his not using electricity; that if a man does not use electricity in his house, his health will not be so good, and if he is not a thorough believer in the articles he sells, he cannot be a convincing salesman.

I am telling my men that the last thing that I want them to do is to advocate anything that they do not believe in themselves and that if they do not believe in electricity they had better not be a salesman for an electric company, but had better go to the gas company or into some other line. On the other hand, if they really believe in electricity they will use it themselves, they will know its advantages, and will be table to talk convincingly.

I am making arrangements so that practically everyone of my solicitors will have at least one or two lamps wired up, and in the cases of those who cannot afford the expense the company is in some cases considering the expense of wiring, say, one lamp in the bedroom and one lamp in the sitting-room, so that a solicitor may in every way have the advantage of electricity and may know it thoroughly when he is trying to sell it.

September Meeting of American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers, which was held in the assembly room of the New York Edison Company on September 28, the recently elected president, Dr. Samuel Sheldon, assumed office and presented his inaugural address entitled "The Work of the Institute." This address sketched the organization of the work of the Institute in the secretary's office and as carried on by the council and its various committees. Secretary Pope reported that at a recent meeting of the board of directors 191 associates were elected, and one associate was transferred to full membership. It was announced that the United Engineering Building will be ready for occupancy about December 1, 1906.

IRON IN MAGNETIC CIRCUITS.

The two technical papers of the meeting dealt with the general subject of iron in magnetic circuits, one by Prof. Frederick Bedell and Mr. Elbert B .Tuttle, treating of the effect of iron in distorting alternating-current wave form, and the other by Mr. Kenneth L. Curtis, having for its subject the current transformer. The first-mentioned paper discussed at length the relation between the harmonics introduced by iron into the current wave and the shape of the hysteresis loop due to these harmonics. For example, it was shown that certain harmonics defined by their amplitude and phase with reference to the fundamental can be produced by iron; others cannot, and these latter are excluded as impossible by the determination of some physical limitation. The condition that hysteresis in iron causes it to absorb rather than to give out energy at once renders certain harmonics impossible. The fact that the current can have a maximum value when coincident with the maximum value of induction in the iron is always a limitation. Again, the fact that after saturation the permeability decreases with the increase of the induction is a further limitation. The current of fundamental frequency is shifted ahead by an angle of hysteretic advance due to the iron, so that it lags less than 90° behind the electromotive force; consequently it represents power, this being the power expended in hysteresis.

In order to ascertain the limiting forms and dimensions of the superposed harmonics, the authors have assumed certain definite values for the harmonics and have then obtained the resultant wave and finally have ascertained the hysteresis loop which would be obtained from such a distorted wave. The hysteresis loops derived in the paper from consideration of the fundamental and third harmonics when in the current wave have an unnatural appearance, particularly near the maximum values. Hence it is concluded that the fifth and other iron harmonics are necessary in the complex wave in order to derive therefrom a very normal hysteresis loop, particularly when saturation in the iron is exceeded.

It was shown that a complete consideration of the values and positions of the several superposed currents requires for their representation the use of distances in at least three dimensions, so that the graphical diagram cannot be plotted on a simple plane. When there are power and wattless components of the fundamental frequency and third and fifth harmonics are present, the separate representation of these quantities in three dimensions is not possible, because each component and each harmonic must be at right angles each to the other, requiring an additional dimension for each harmonic above the third. This complex representation is, however, unnecessary, for, since all superposed harmonics are wattless, their collective representation as one line in the third dimension meets all requirements. Components of different frequencies when represented in the third dimension are not to be combined vectorially, but are to be added by taking the square root of the sum of the separate squares.

The discussion on Prof. Bedell's paper was opened by Dr. C. P. Steinmetz, who commented on the great value of the paper from a theoretical standpoint and of the increasing importance of a study of wave distortion as affecting the operation of transformers and transmission lines. The usual method of studying the distortion in the exciting current wave due to the presence of hysteresis is to resolve a known exciting current wave into its fundamental and certain harmonics. Prof. Bedell, however, has attacked the problem in a reversed manner. He has assumed a fundamental and then has ascertained what harmonics can be introduced in order to produce possible hysteresis waves. The paper is incomplete in that it omits harmonics higher than the triple frequency. The conclusions derived with reference to the limits in the value of the third harmonic which may be present will be greatly modified if a fifth harmonic is assumed to exist simultaneously with the third. It is proper to assume that the magnetizing current cannot possess two humps, and this limiting condition at once places a maximum value on a single superposed third harmonic. When the fifth harmonic is present, however, the third can be greatly increased because the positive and negative values of the fifth harmonic may be in such positions as to remove the hump from the resultant wave.

An interesting and valuable method of analyzing the distorted current wave is to ascertain that component which is in phase with the flux and that component which is in phase with the electromotive force. When such method is employed it is found that the component in phase with the electromotive force is approximately sinusoidal, while the component in phase with the flux is very greatly distorted. This fact leads one to the conclusion that the distortion is due almost exclusively to the saturation, while the hysteric angle of advance is due almost entirely to the energy loss.

In regard to the statement in the paper that it is impossible for the hysteresis loop to be traversed in the negative direction, which would imply that the core is giving out energy instead of receiving it, it is well to mention the fact that such conditions can be obtained. Thus if mechanical means are employed to produce synchronously varying reluctance in a given magnetic circuit, the area of the hysteresis loop will depend upon the relative instantaneous value of the reactance as compared with the magnetic flux demanded by the electromotive force, and it is entirely possible to cause the area of the hysteresis loop to disappear and then to reappear with a negative value. When two exciting coils are placed in mechanical quadrature and are subjected to electromotive forces in electrical time quadrature, as is well known, a revolving field will be produced. If in this revolving field a circular iron disc be placed, the disc will experience a tendency to rotation in the direction of the revolving field. When the disc is stationary a certain amount of loss is produced in the coil and this loss must be supplied by a power component of the exciting current in the separate coils. When the disc is rotating at a certain low speed the magnetism in the disc must pass through a hysteretic cycle, the frequency of which varies with the slip of the disc from synchronous speed. The energy loss in the disc, therefore, varies approximately with the slip, but the exciting current supplied to the separate coils has a practically constant value independent of the slip. The excess of power supplied above that utilized in overcoming the losses in the disc appears as mechanical power at the rotating disc, the torque of the disc being constant until synchronous speed is reached. At synchronous speed both the torque and the loss in the disc disappear and the power supplied by the exciting coils reduces the zero. At speeds above synchronism the torque is negative, and the apparent hysteresis loop as observed in the exciting coils possesses also a negative area.

A practical application of the results obtained from studying distorted exciting current waves is to be found when the primaries of three-phase transformers are connected in delta. If the impressed electromotive force is sinusoidal the exciting current wave must be distorted and must contain very pronounced triple harmonics. The fundamental current waves in the separate transformers are displaced in time by 120°, and therefore the triple harmonic waves will be displaced by 360°. The significance of this result is that the triple harmonic waves act as though they were in a single series circuit and they do not appear in the external circuit. That is to say, the exciting current to the transformers as measured in the supply lead will be devoid of triple harmonic waves, while the triple harmonic current will flow in a local circuit, including the three transformers. In star-connected, three-phase transformer primaries when sine electromotive forces are impressed across the supply leads, then there can be no local triple harmonic exciting current. In this

event, however, the separate electromotive forces are not sinusoidal, but each contains a triple harmonic distorting component. Thus the neutral point of an insulated star-connected, three-phase transmission system does not assume the potential of the ground, but between the ground and the neutral point there exists a triple frequency electromotive force which may produce serious surges through the electrostatic capacity to the ground which is in series locally with the local inductive reactance of the transformers.

Prof. Franklin, in discussing the paper, suggested that the term "harmonic" electromotive force is preferable to "sinusoidal" on account of the fact that the word "harmonic" is universally employed to designate motion, the value of which may be represented by a sine function of the time. In problems connected with the distorted electromotive forces of generators it is best to resolve the electromotive forces into simple harmonic functions and to treat each one separately and then to solve the separate problems. On account of the numerous definitions which have been given to the term "hysteric angle of advance," it seems best to define such angle as the one which would be obtained by the use of simple voltmeters, ammeters and wattmeters. He expressed the opinion that the various phenomena connected with hysteresis cannot be formulated, and that it is useless to attempt to do so.

Mr. Philip Torchio stated that the triple harmonics mentioned by Dr. Steinmetz as existing in three-phase systems have actually been observed in cases where the system was star connected and the neutral was grounded.

A paper by Mr. Kenneth L. Curtis on the "Current Transformer" was abstracted by Dr. A. S. McAllister in the absence of the author. The paper dealt with both the design and the operation of the current transformer. After having explained the characteristic features of the device by means of vector diagrams, the author showed a simple method for obtaining a sine wave current of desired value through an unknown inductive reactance in order to determine the coefficient of self-induction of the reactance. The method consists in placing a hot wire voltmeter in parallel with the reactance coil of which the coefficient of self-induction is to be determined. The current through the voltmeter being known from its resistance and the reading of its scale, and the total current in the line being determined, the current which passes through the reactance coil is ascertained as the vector difference between the total and the voltmeter current. The determination is made by means of a simple graphical diagram. The author showed that in a well-constructed current transformer the local leakage reactance is practically negligible in comparison with the inductive reactance of commercial indicating wattmeters, indicating ammeters or watt-hour meters. Basing his conclusions on the application of ratios of a certain current transformer under average working conditions with various values of resistances and reactances in the secondary circuit, the author showed that the factor which prevents a constant ratio of secondary to primary current for all loads is the exciting ampere-turns. The smaller these are in proportion to the total ampere-turns of the transformer and the lower the power factor of the exciting current the more nearly will a constant ratio be obtained. Assuming the secondary to have as low resistance and reactance as is practicable, to obtain the best results the magnetic circuit must have as low values of reluctance, hysteresis and eddy currents as possible. That is to say, if the secondary has as low resistance and reactance as is practicable the best current transformer will be the one containing the most iron of the best quality in the form of the thinnest laminations.

Mr. Curtis's paper was discussed by Mr. Louis Robinson, who exhibited numerous curves obtained from the test of current transformers. He expressed the opinion that it is far preferable to obtain the information concerning the operation of such transformers by actual observations, rather than by calculations, because the calculations, in order to be exact, would require the taking into account of all distorting influences, such as a non-sinusoidal primary current, etc. In numerous cases it is of more importance to obtain a correct phase angle between the primary and secondary currents than to obtain the correct ratio in the values of such currents. This is especially true when current transformers are used with wattmeters or watt-hour meters. In current transformers the universal practice is to operate the iron at a low magnetic density; although much work has been done with iron at such densities, nevertheless it is true that very little is known about the behavior of iron under such conditions. It may be stated that in the construction of current transformers more attention should be given to the core than to the coils because upon the core depend almost entirely the operating characteristics of the device.

The Expansion of the Telephone Industry.

No part of the electrical field to-day is enjoying a more rapid development than telephony, and some remarkable statistics have been compiled by the *Wall Street Journal* bearing upon the expansion of the Bell telephone interests in the hands of the American Telephone & Telegraph Company. The data compiled are quoted below:

Few people have any adequate conception of the construction requirements of the Bell companies. During the past six years they have expended for new construction and real estate no less than $219,547,906, divided by years as follows:

1900	$31,619,100
1901	31,005,400
1902	37,336,500
1903	35,368,700
1904	33,436,700
1905	50,780,906

The fact is not generally appreciated that on the basis of last year's business the total daily average of Bell telephone connections throughout the United States was 13,911,000, or at the rate of about 4,479,500,000 per year, being 54 telephone calls for each man, woman and child in the United States. Only six years ago the annual number of calls was 1,708,800,000, the increase to January 1 last being 160 per cent. It is increases in business like this, almost staggering in their immensity, which the American Telephone directors are called upon to finance. At the end of last year the Bell companies had in use no less than 320,000,000 pounds of copper wire, worth on the present copper market $62,400,000.

The net output of instruments for the first eight months of this year was 960,520, although much to the relief of the overworked construction department, the August statement in both gross and net output of instruments was the smallest of any month this year. The average output of the first six months of each of the past five years has been very close to 50 per cent of the entire outputs of each of those years. On this basis it is conservative to estimate the total net output for 1906 at approximately double the figures for the first six months, or, say, 1,600,000 instruments.

The following table shows the instruments outstanding at the end of each of the past seven years, the figures for the current year being estimated:

Instruments.

Year.	Outstanding.	Increase.	Per cent. Increase.
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7
1903	3,779,517	629,197	19.9
1904	4,480,564	701,047	15.8
1905	5,698,258	1,217,694	27.1
1906 (estimated)	7,298,000	1,600,000	28.0

The instrument statement offers a basis upon which to figure earnings. The ratio of subscribers' stations to instruments is about 44 per cent. The gain in 1906 net earnings figures as follows:

Gain in subscribers' stations	704,000
Increase in gross at $45 per station	$31,680,000
Increase in expenses, 74% of gross	23,443,200
Increase in net	8,236,800
Am. Tel. Co.'s shares, 56%	4,612,608

To the above gain of $4,612,608 must be added at least $1,500,000 to represent the increase in long-distance profits and the increase in rentals of instruments. A conservative estimate of the American Telephone Company's increased profits this year is, therefore, $6,000,000. If undivided equities are taken into consideration it is not difficult to figure an earning power of 13 per cent on the outstanding stock of the parent company.

The First Public Telharmonic Concert.

The rapidity with which the new electrical industry for the distribution of music directly from a generating plant is making headway was evidenced last week by the giving of the first public telharmonic concert with the Cahill dynamophone at the first central station of the system, Broadway and Thirty-ninth Street. This remarkable concert was the first meeting for the season of the New York Electrical Society, and the intense interest of the public in this new development was manifested by the extraordinary size of the audience. The average meeting of the Society attracts an attendance of about 300, but on the evening of September 26 over nine hundred people presented the cards of the Society at the door, and as the auditorium will only accommodate about two hundred and fifty the resultant crush can be better imagined than described. Prior to the concert the generating plant in the basement was thrown fully open to the visitors, and the dynamophone driven by electric motor, the relay board, the transformer tone mixers, the "Douma" where several hundred telephones are in circuit but are kept gagged and sand bagged, were all inspected with great curiosity and eagerness by a most representative gathering of electricians, physicists and the technical public generally. President Condict, of the Society, introduced Mr. Oscar T. Crosby, who has followed up the work of Dr. Thaddeus Cahill, and is interested in the exploitation of the enterprise. Mr. Crosby delivered a brilliant

TELHARMONIUM CONCERT ROOM, SHOWING METHOD OF CONCEALING OUTLETS.

address in explanation of the invention, whose broad features are already familiar to our readers. He pointed out that each small alternating-current dynamo constituting part of the dynamophone generated a special current, whose musical note corresponded to the frequency, and that these currents through the apparatus and the keyboard on which the performer played could be so compounded that musical notes were heard in the receiving telephone and regular compositions could be rendered. He further pointed out that the keyboard could be operated just as that of a piano or an organ, and that it would even be possible to employ some mechanical attachment playing as the pianola does, although that would not give the delicate expression of the individual performer, which was one of the charms of this new music as distinguished from what is usually known as mechanical music. From the keyboard the music is delivered to as many telephones as may be in circuit, the plant in New York, driven by a motor of 200 hp on the Edison mains, having a capacity to supply 15,000 or 20,000 outlets, which might mean just that number of rooms or halls and 100,000 people.

The auditorium in which Mr. Crosby spoke, a view of which is here presented, is about 50 by 80 ft., of lofty pitch, and is now equipped with eight telephonic outlets, which are merely ordinary telephones equipped with horns of the megaphone type, these being concealed in baskets of ferns, hydrangea bushes, divans, columns, trelliswork, etc., in such a way that it requires a quick ear to detect readily the source from which the music is coming. Mr. Crosby stated that in addition to the keyboard at which they saw the performers playing other keyboards were to be set up in the room so that subscribers could choose their music. If one set of musicians are playing rag-time on the first circuit, another set could give Chopin on the second circuit and still others could give Wagner on a third circuit. In addition to this central station service in any one city or town, those who felt they could afford it and who desired to make their own music absolutely as it is made by direct playing on any of the familiar instruments, might do so by a small telharmonic installation corresponding to the small electric plants put in any hotel or private building, and such a plant, moreover, would have no connection whatever with the central station music plant, requiring only a small amount of electric power to drive it. While these small plants might be quite expensive at first it is not unlikely that in a few years they can be sold at approximately the price of a high-grade piano, but the comparison was unfair in the sense that the telharmonic music could be delivered in every room in the house or out on the lawn, or anywhere at will in the vicinity. Mr. Crosby brought out a number of other interesting points, all of them bearing upon the feasibility and practicability of this new musical system and going to show that a new art has been born which, in its range of application, its utility and pleasure for mankind and its profit-earning ability, compares favorably with the electric light, telephone and the trolley.

A programme of music was then given comprising several numbers by the staff of musicians already proficient with the new instrument, who played singly or in duets and who also, besides high-class music, gave a number of imitations of other instruments and of effects, such as the passing of a drum and fife corps. Additional evidence of the beauty of the music and the flexibility of the system was given in the accompaniment of three or four songs in which the telharmonium followed the rich voice of Miss Fiske through all the shades of expression. Dr. Ganz, of the Stevens Institute of Technology, in proposing the motion of thanks, remarked that they had been listening to a new instrument which summed up all other musical instruments. Prof. Hallock, of Columbia University, seconded the vote. After the concert a large number of members lingered for a considerable time to study the apparatus and to secure further explanation of its remarkable qualities and capacities. It is understood that by the end of October the auditorium in which the meeting was held will be ready for the giving of regular concerts to the public, by which time also music can be delivered beyond the walls of the building, for which purpose separate telephone cables are already being drawn in up and down Broadway, tapping a district where it is said more music is ground out to the square foot than any other place in the world.

German Electrical and Machinery Industry.

United States Consul-General Richard Guenther, of Frankfort, reports that the manufacture of machinery in Germany has increased at a rapid rate, especially during the last half of 1905. He says: "In the whole field of machinery manufacture employment at fair wages was steady. The erection of new manufacturing establishments and the enlargement of existing ones, gave the machinery industry many orders. Both the automobile and rubber industry have increased rapidly and could not keep up with the demand. In the steam-engine branch competition by gas and electric motors was keenly felt, although employment was adequate and the prospects for the coming year are good. The manufacture of compressed air tools and machinery has assumed great proportions, and the prospects for 1906 are such that large additions are planned to existing works.

The volume of business in the manufacture of milling machinery has increased considerably over the previous year. A trust of the large German establishments try to regulate prices and terms. Employment in the factories of ventilators and centrifugal pumps has been good, many firms working night shifts. There are more than fifty firms in Germany manufacturing cen-

trifugal pumps. In the electrical industry business was fairly satisfactory. Wages showed an upward tendency, being 10 to 15 per cent higher than in 1904. Work in the industry of electric lighting, transmission of power, etc., was good, especially in the last half of 1905; so, too, in the manufacture of electrical measuring instruments and all electro-technical articles.

Illuminating Engineering Society.

A meeting of the Illuminating Engineering Society will be held in the Edison Auditorium, 44 West Twenty-seventh Street, New York, Friday, October 12. Two papers on "Data of Indoor Illumination" will be presented, one by Mr. J. E. Woodwell, inspector of electric lighting plants, United States Treasury Department, and the other by Mr. E. C. White, illuminating engineer, Winnipeg, Manitoba. At this meeting the membership of New York City and vicinity will be organized as the New York section of the society.

The Pittsburg Section of the Illuminating Engineering Society, organized September 12, already numbers more than 60 members, and a canvass is now being made which will probably soon carry the membership beyond the 100 mark. The section was organized as above stated, on September 12, at a meeting of which Mr. G. Brewer Griffin acted as chairman, and Mr. J. C. McQuiston as secretary. Remarks were made by Messrs. Max Harris, C. B. Humphrey, E. R. Roberts, George A. Nellis, and F. W. Andrew, all of whom spoke enthusiastically in favor of the movement which was culminated in the formation of the Illuminating Engineering Society. A committee consisting of Messrs. Max Harris and George A. Nellis was appointed to secure a meeting place for the section, and Messrs. Robert M. Morris and W. I. Pattison were constituted a committee on membership.

The membership of the Illuminating Engineering Society now exceeds 700, and at the rate additions are being made, will pass the 1,000 mark before the end of the year. The secretary is Dr. A. H. Elliott, 4 Irving Place, New York, who will furnish information to those desiring to join the society. The membership fee is $5 per annum; no entrance fee at present is required. All members receive the Transactions of the Society, which is published monthly except during the summer months.

CURRENT NEWS AND NOTES.

U. OF P. ENGINEERING BUILDING.—The new engineering building of the University of Pennsylvania will be dedicated October 19 with appropriate ceremonies. Representatives will be present from foreign governments and from the leading engineering schools and scientific schools of this country, and honorary degrees will be conferred on a number of prominent engineers. The building has been in course of construction for some three years and no expense has been spared in its details and equipment to make it surpass anything of the kind in this country or abroad.

STANDARD SYMBOLS.—The standard symbols for electrical work to which attention was recently drawn in these pages have been copyrighted by the National Electrical Contractors' Association, which proposes to promote and advocate their general adoption in the same manner that the National Electrical Code has been made universal for practice under the fire insurance rules. It is hoped and believed that the good work thus begun by the association and that the standard symbols will soon become recognized everywhere throughout the country by manufacturers, contractors, draftsmen and all others having to use such symbols in their work, drawings, specifications, etc.

EVENING COURSE IN DIRECT-CURRENT TESTING.—The evening sessions in direct-current dynamo testing were begun Thursday evening, September 27, at 7.30 p.m., at the Polytechnic Institute of Brooklyn, under the direction of the class instructor, Mr. Sydney W. Ashe. This course extends over a period of 20 successive evenings from 7.30 to 9.30 and is similar to the high-grade testing given on the day courses. The course involves a series of tests of the construction, regulation, efficiency and operation of direct-current dynamos and motors, together with a consideration of the efficiency and distribution of light, and the candle-power of arc and incandescent lamps. From those desiring to have their work credited towards the degree of E. E., reports upon the tests performed will be exacted.

TELEPHONE AND TROLLEY TROUBLE.—It appears that trouble of an expensive character is brewing between the telephone companies and the traction lines of Northern Indiana, which are operated by the alternating-current system. Threats are freely made to carry the matter to the courts, and ultimately to the incoming legislature. The contention between the traction and telephone companies is due to the fact that the single-phase system causes trouble on nearby telephone lines, thereby making conversation impossible, and jeopardizing telephone equipment. Hostilities have broken out in Allen County and is likely to spread to the other parts of the State where the single-phase system is used. The Central Union and Home Telephone Companies, of Ft. Wayne, state that they have been compelled to move their wires, which parallel the newly completed Ft. Wayne branch of the Toledo & Chicago Traction line; and they have served notice on the traction company that the burden of expense will be thrust upon it. In case of denial of liability the matter will be taken to the courts. Their contention is that the only reliable prevention is the complete separation of the two sets of wires, and consequently the telephone wires along the line complained of have been removed a half a mile west by the telephone company.

GROWTH OF N. E. L. A.—At a recent meeting of the Executive Committee of the National Electric Light Association the matter of offices in the United Engineering Society Building was finally decided, and the association will therefore change its headquarters as soon as practicable after the new building is ready for occupancy. There was an unusually full attendance at the meeting, and several very important measures for the benefit of the association were set in motion. Among the new applications for membership passed upon and approved were the following: Class A—North Georgia Electric Company, Gainesville, Ga.; Millville Electric Light Company, Millville, N. J.; McCall Ferry Power Company, New York; The Miami Light, Heat & Power Company, Piqua, Ohio; Laramie Light & Power Company, Laramie, Wyo.; Albany Power & Manufacturing Company, Albany, Ga.; Toledo Gas, Electric & Heating Company, Toledo, Ohio; Escambia County Electric Light & Power Company, Pensacola, Fla. Class B—E. J .Fowler, Chicago Edison Company, Chicago, Ill.; J. W. Murray, The Allegheny County Light Company, Pittsburg, Pa.; A. S. Allen, Tonawanda Power Company, Tonawanda, N. Y.; C. H. Patten, Chattanooga Electric Company, Chattanooga, Tenn.; Arthur L. Linn, Rochester Railway & Light Company, Rochester, N. Y.; E. A. Phinney, The Ouray Electric Power & Light Company, Ouray, Colo.; Henry Stephenson, The New York Edison Company, New York; J. W. Young, McCall Ferry Power Company, New York; H. M. Edwards, The New York Edison Company, New York; Charles S. Shepard, The New York Edison Company, New York; William S. Dupont, Public Service Corporation of New Jersey, Newark, N. J.; James J. Whittlesey, Public Service Corporation of New Jersey, Montclair, N. J.; J. Kennedy, Public Service Corporation of New Jersey, Weehawken Heights, N. J.; Edward J. O'Beirne, Gainesville Electric Railway & Light Company, Gainesville, Tex. Class D—Michaelis & Ellsworth, New York; Roderick J. Parke, Toronto, Can.; The Lundin Electric & Machine Company, Boston, Mass.; Condit Electrical Manufacturing Company, Boston, Mass.; The Shelby Electric Company, Philadelphia, Pa. Class E—James D. Ellsworth, Michaelis & Ellsworth, New York.

NAVY ELECTRICAL DRAFTSMAN.—An examination of applicants is to be held at the Navy Yard, Charleston, S. C., on October 10, for the position of first-class assistant electrical draftsman at $4 per day. Applications should be addressed to the commandant of that yard, giving residence, citizenship, present occupation and previous employment or work done.

ELECTRIC OVERCOAT.—A special dispatch from Paris of September 29 says: "Camille Hergot, a French engineer, has patented an 'electric thermophile,' which consists of electric wires distributed inside of the ordinary man's clothes. A light battery in the pockets of the wearer will furnish the desired heat and maintain an even temperature, so that no stove will be necessary at home to keep him warm or a hot brick in church to toast his feet." We are a little inclined to question the "lightness of the battery."

INTERNATIONAL ELECTRICAL STANDARDIZATION.—A meeting was held this summer in London at which an organization of an International Electrotechnical Commission was effected. Ten countries were represented at the meeting, each of which will be represented on the commission, as permanently organized. The American Institute of Electrical Engineers was represented by a committee of which Prof. F. B. Crocker was chairman. The first meeting of the commission will probably be held next year.

STUDENTS BUILDING A RAILWAY.—Arrangements have been made whereby thirteen miles of electric railway, a part of the system planned by the company incorporated to construct a road from this city to Chicago, will be built by the students of Purdue University. The officers of the company and the faculty of the university have made arrangements whereby the students will have full charge of the work of building the first section of the road, and they have already begun the survey under the guidance of the members of the faculty. This reminds one of the work done many years ago in England, when the students at one of the English universities, under the stimulus of John Ruskin's fervid eloquence, went in for a bout of road making, with pick, shovel and roller.

THE FIRST CENTRAL TRAIN.—On Sunday afternoon, September 30, with Vice-President W. J. Wilgus as its motorman, the first New York Central electric train ran into the city and through the tunnel to the Grand Central depot, making a speed over the viaduct entering the tunnel of 55 miles an hour. The train weighed 550 tons and among its passengers were officials of the New York Central, General Electric and Westinghouse Companies, all deeply interested in the execution and completion of the whole great enterprise of equipping the "electric zone." The train ran very nicely and the remainder of the necessary work is being pushed with all imaginable speed and activity.

BURNING WORDS.—Electricity has done its share in burning up the world, but it takes little to make electricity free from risk of any kind in its use. The International Society of Building Commissioners and Inspectors calls attention to the fact that there are in the United States eleven and a half million buildings, valued at fourteen billion five hundred million dollars, or more than all the railroads in the country put together, and it asserts that of all these just one is absolutely fire-proof. That one was built in Chicago by the great insurance companies for a testing laboratory. There are only four thousand buildings—about one in three thousand—that are even nominally fire-proof, and these can be damaged in a conflagration to the extent of from thirty to ninety per cent of their value. Yet the unburnable Underwriters' Laboratory in Chicago, with its walls of vitrified brick, floors, roof and partitions of semi-porous, hollow terra-cotta, door and window openings framed in rolled steel, window frames and sashes of sheet metal, doors of filled copper and steel, and stairs of hollow terra-cotta, cost only twelve per cent more than a building that would shrivel up at the first breath of an advancing fire.

BOSTON MUNICIPAL OWNERSHIP.—It appears that the advocates of municipal lighting received another set-back at the last meeting of the special committee of the Boston city council, when an order calling for municipal lighting was voted down. There are 15 members on the committee and 14 were present at this executive session. The committee was in session for nearly two hours, and it was a lively meeting. After several ineffectual attempts to have an order reported calling for municipal ownership of lighting plants the advocates of the measure had to give it up, and the committee adjourned. It was the last day for the committee to make its report under the order by which it was created, and it was for that reason that the advocates of municipal lighting worked hard to have action taken. This failure is regarded as the end of the agitation for this year. There has been but little interest in the measure since the committee was appointed. At several of the sessions of the committee the attendance was slim and there was even considerable difficulty in getting a quorum. The public of Boston has also betrayed little or no interest in the matter in spite of the frantic effort of such men as Hearst and "Prof." Parsons.

CROSSING OF HIGH-TENSION WIRES.—In an editorial discussion of the dangers from crossing high-tension wires, the *Engineering Record* says: "Aside from the danger to life which faulty overhead construction entails, there is always the possibility of fires being started over a wide area in case a high and low potential contact occurs—provided the protective devices fail to do their work. The financial loss in such cases is likely to exceed the cost of proper protection a good many times over. A recent trip in Northern New England showed so many examples of inferior line construction—in some cases carrying 12,000 or 13,000 volts—that the hazard of the situation was most forcibly apparent. It naturally costs money to maintain overhead lines in first-class condition, but it is a matter of comparatively small expense per crossing to take a reasonable regard for the safety of adjacent high and low-tension circuits. An example of the simplicity with which such protection can be made is found at the Boston & Maine shops in Concord, N. H. Here a three-phase, 13,000-volt circuit is carried across the railroad tracks in a long span, directly over a pole line carrying two or three score of telephone wires. The power circuit is bare, and is supported on the usual porcelain insulators, but at short intervals each wire of the line is additionally protected from falling by vertical tie wires suspended from three overhead wires attached to an upper cross arm, each power wire having what amounts to a short-span catenary suspension throughout the crossing. The cost of the protection could scarcely have exceeded $10."

CANADIAN POWER.—The third report of the Ontario hydro-electric commission deals with the Lake Huron and Georgian Bay districts. The province is divided into eight divisions, and the two reports and the first and second reports dealt with the Niagara and the Trent Valley districts, respectively. In the Georgian Bay and Lake Huron districts the commission report the demand for energy at over 1,600 hp. A careful study has been made of the present probable demands for electric power developments capable of supplying these demands and five developments have appeared to be worthy of serious consideration. Among the possible undeveloped locations are mentioned the Maitland River, Tugenia Falls, the Big Chute of the Severn River, the Sturgeon River and Falls, the Moon, Muskoka, Magnetawan, French and Wahnapitae Rivers. An estimate of cost of development has been made by a test at Collingwood, and the saving on the present steam operation noted. The capital cost is illustrated by undertakings now operating at Sudbury, $120,000; Bracebridge, $75,500; Orillia, $250,000. The following warning remark is to be noted: "It is imperative that the waters of the Severn, Muskoka and other rivers not yet leased by the crown be retained for the use of the many municipalities which must, for all time, depend on these sources for whatever electrical energy they may obtain from water power to be granted in the future, such lease should specify the rates at which the hydro-electric power commission may obtain electric power in a condition and quantity at the generating points ready for transmission, or at the points of delivery in the various municipalities."

ENGLISH WAGES.—As the result of an application from employes for an increase of wages, the Salford, England, Tramways Committee has recommended to the municipality, which owns and operates the line, that the wages of conductors be raised to 11 cents per hour on appointment, 12 cents per hour after one year's service, and 13 cents per hour after three years' service. Another municipality advertises for a carshed night foreman at $9 per week.

ENGLISH CENTRAL STATION PERIODICALS.—The various central station companies of London have co-operated in the issue of a quarterly central station publication entitled *"Electrical Bulletins. A Quarterly Budget of Information for Electricity Users."* The only other publication of the kind in England is the *Tyneside Electrical Pioneer,* which is now in its third year. Almost a score of American central stations publish regular periodicals for advancing their interests, usually issued monthly.

OXFORD TO BE TROLLEYED.—A cable dispatch from London of September 29 says: "Oxford as the home of lost causes has clung tenaciously to horse tramways. The city council, after setting its face sternly against municipalization, has accepted the tender of a private construction company for the electrification and the lease of the tramways, overhead wires being excluded. There was a choice between the surface contact systems and side slot conduits, and the Dolter method has been preferred, with the reservation that it will not be introduced until it has been satisfactorily tested at Rotherham or elsewhere for a period of six months. The council may not have made a good bargain, but the promise of electric tramways is a sign that the world moves, even at Oxford."

THE LIGHT OF OTHER DAYS.—Electricity and gas do not have it all their own way, for while whale oil and cocoanut oil no longer compete severely in the world of artificial illumination, kerosene is a large factor, and the candle is not extinct. The bureau of manufactures in the Department of Commerce and Labor reports that this country has an export trade in candles worth about $700,000 a year, or more than it exports of incandescent lamps, it is said. But Great Britain did an export trade in candles of $3,178,000 and France in 1904 shipped out $1,218,500. The chief markets, apparently, are the Cape of Good Hope, Natal, Portuguese East Africa, Morocco, China and Chili. Africa is still nearest the candle age, being by far the largest consumer. Her "candle-power" is excessive.

BELGIAN RAILWAYS.—A writer in the *Revue Politique et Parlementaire* of France notes the results of government ownership of railways in Belgium as bad. Since the State acquired control the cost of administration in every department, he shows, is higher, while trains are slower and more unpunctual. The operating expenses of the Northern Railway of France absorb 52 per cent of receipts, but on the Belgian railways operating expenses are 60 per cent, and this, too, in a country where population is three times as dense, receipts per mile are much higher and iron is cheaper. Quoting official figures, the writer proves that the higher cost of the State-owned Belgian railway does not mean better service or even higher wages. The only people who benefit by the change from private to public ownership, the writer shows, are a number of high officials whose offices and salaries did not previously exist, and members of the Chamber of Deputies.

RECOUNT ESTABLISHES DENVER FRANCHISES.—At the election in Denver last spring, as most of our readers know, the voters of Denver decided in favor of granting an extension of franchise to the Denver Gas & Electric Company by a majority of 516, and to the Denver City Tramway Company by a majority of 187, the total vote being about 16,000. Soon after election the local yellow journals and hungry politicians of the city, aided by some municipal ownership advocates, raised a great cry about election frauds. A complicated legal tangle resulted in which one of the sensational features was the temporary lodgment in jail for contempt of court of Mr. H. L. Doherty, president of the Denver Gas & Electric Company and others. Mr. Doherty held court in contempt and said so, because he believed that particular court was acting outside of its jurisdiction. The recount of the ballots was completed September 21 by Judge Lindsey's court and showed only the very slight errors in counting that would naturally occur in any such operation. There were no evidences of fraud, and the figures stand.

ELECTROPLATED COINS.—The Paris correspondent of the New York *Tribune* gives an interesting account of the production and detection of new counterfeit coins in France. The letter contains the following paragraph: "The French detective police have discovered a band of counterfeiters who in the last few months have put into circulation nearly $60,000 worth of false 10-franc pieces. These false coins are made from crystal. They have the exact weight and produce the same ringing sound when tossed upon a counter, as the genuine gold pieces. This is the first time in France that crystal has been employed in counterfeiting. The similarity of the false and true coins is remarkable. By a most ingenious process the melted crystal, when at a temperature of 100° C., is forced into moulds and assumes the exact counterpart of the familiar 10-franc pieces bearing the head of Napoleon III, dated 1859. By another equally skillful method, known technically as that of "galvano-plastrie," the crystal coins are covered with a fine film of gold such as that used in dental surgery. The only defect in the process is that the false coins are so brittle that when thrown with force upon a marble slab they break into splinters like glass."

WATER POWER ECONOMIES.—It is stated that the co-operative work carried on in Wisconsin by the State and the United States Geological Survey has been productive of important results, particularly that part of it pertaining to the Wisconsin River, where it has been estimated that over 100,000 hp is now going to waste. During the past season the survey of the river between Kilbourn and Tomahawk dam has been completed, and a map and profile of the stream have been made. In the section surveyed 193 miles long, the river falls 617 ft. This fall furnishes thirty or more dam sites, seventeen of which are already developed. The total amount of head which could be developed at a reasonable cost, according to the survey, is not less than 465 ft., but only 235 ft. have been developed. With the view of ascertaining the adaptability to industrial purposes of the waters of the Potomac River at Cumberland, Md., the Lehigh River at South Bethlehem, Pa., and the Grand River at Grand Rapids, Mich., it has been arranged to have samples of the waters of the streams at those points forwarded to Washington daily for analysis.

TELEPHONY IN CHICAGO.—Mayor Dunne, of Chicago, has been dealing with the vexed question of telephonic competition in that city, and in a recent message to the city council on the application of the Illinois Manufacturers' Association for an ordinance remarks: "In my judgment the telephone service of a city is essentially a monopoly and until the city is empowered by law to undertake the giving of telephone service to its citizens it should be performed by one company and that company should be compelled to give efficient modern up-to-date service at just and reasonable rates, which rates should be much below the rates hitherto imposed upon the citizens of this city. I would, therefore, respectfully recommend that the matter of determining what are just and reasonable rates to be charged the City of Chicago for telephone service should be referred to some appropriate committee or to a special committee constituted for that purpose, and that the said committee be empowered at once to secure the assistance of competent telephone engineers to ascertain and determine what are just and reasonable rates for telephone service in this city, and having ascertained what these rates should be to formulate a policy which will secure efficient modern service at just and reasonable rates, which policy should reserve to the city the right to operate a municipal telephone plant when empowered so to do by the legislature of this State."

Power Plant of the Lackawanna Light Company of Scranton, Pa.

THE Lackawanna Light Company has just completed what is acknowledged to be the finest central station in the Wyoming and Lackawanna valleys. The site, which comprises some three acres at the corner of Sanderson Avenue and Glen Street, Scranton, is directly opposite the Delaware & Hudson Railroad tracks and the Manville breaker. The power house is an unostentatious steel and brick structure divided longitudinally by a brick wall into boiler and dynamo rooms. The use of a ferroinclave concrete roof in connection with the steel frame and brick walls makes a building which is absolutely fireproof. Ground was broken on March 23 of this year and by September 1 not only was a modern central station with a capacity of 2,000 electrical horse-power complete, but several miles of iron pole line were erected, 30 miles of underground conduit constructed, 12 miles of underground cable laid and a whole electric light system, including a sub-station, was in actual operation. The rapidity and thoroughness with which the work was done show that the management possesses no mean technical or business ability; and indeed such is required if success is to be assured with several other lighting companies already in the field.

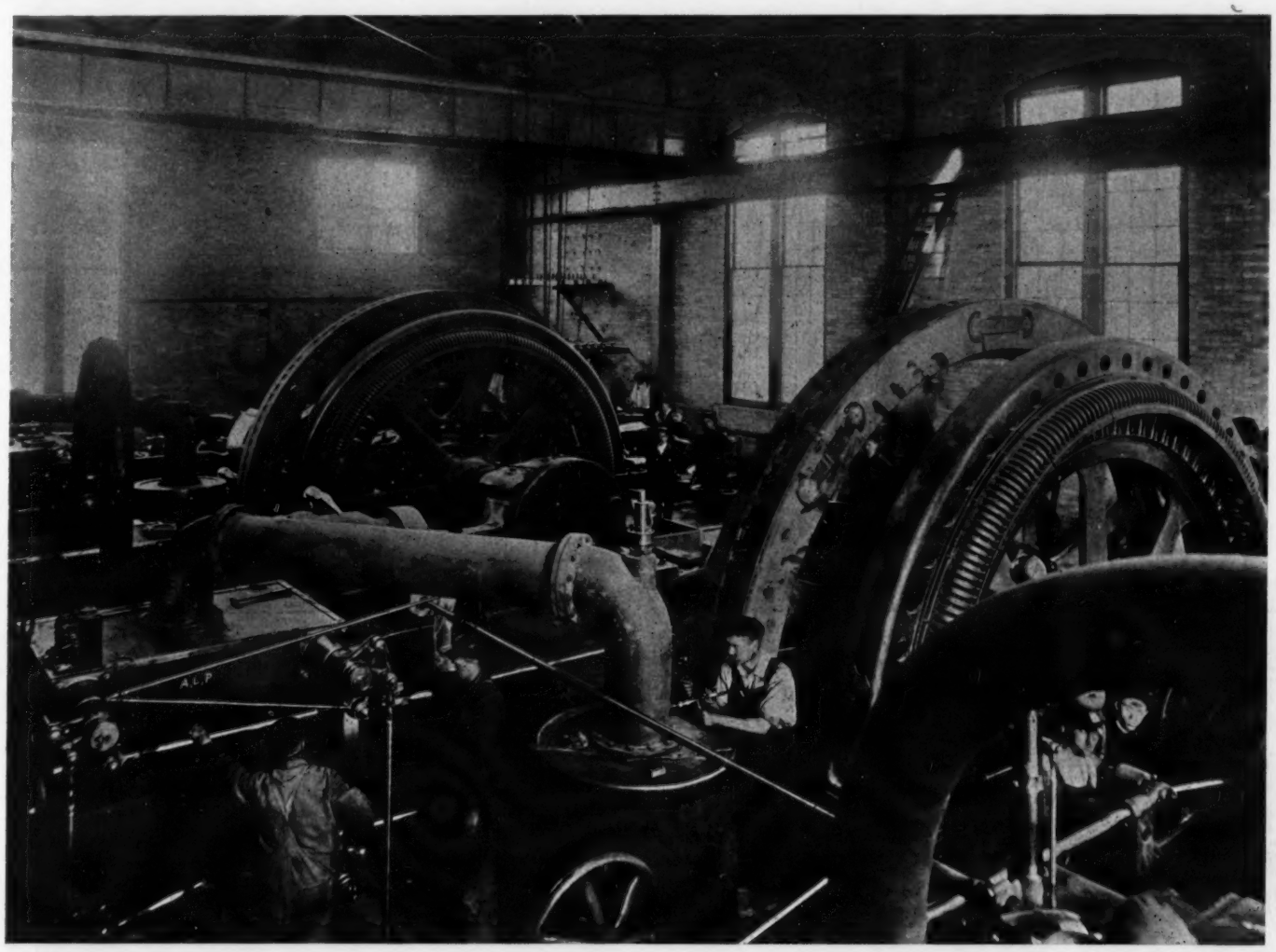


FIG. 1.—GENERATOR ROOM OF THE LACKAWANNA LIGHT COMPANY, SCRANTON, PA.

As might be inferred from Fig. 2, the station is advantageously situated as regards fuel supply; but had the franchise of the company been less stringent with reference to the location of the station within the city limits, the fuel question would have had a very happy solution. Outside the city are a number of huge culm piles alongside of which a central station could be erected. These culm piles contain anthracite coal from pea coal to the finest buckwheat, all of which can be readily burned in Dutch ovens with shaking grates. The culm piles within the city limits are all being worked over for these finer sizes of anthracite, and although coal is very cheap in Scranton, a very great saving is possible where a central station company owns a culm pile that it can work over for its fuel, which is an important item of expense in the generation of electricity.

The boiler room contains four Stirling water-tube boilers arranged in two batteries, the total rated capacity being 1,600 hp. Each boiler has a grate area of 131 sq. ft., 90 per cent of which is covered by a reverberatory arch of glass furnace fire brick. The boilers are equipped with shaking grates supplied by the Scranton Steam Pump Company, which are designed to burn the smallest sizes of anthracite fuel. The furnace construction follows the latest practice in this respect. Forced draft is of course used and this is supplied normally by a steam-driven fan which takes air either from the engine room or from outside the building and discharges it into an underground duct extending from the engine room and running along the front of the battery of boilers. From this duct smaller branches, two to each boiler, extend into the ash pit, to which air is admitted in the requisite amounts through special dampers operated by levers at the boiler fronts.

With the size of coal burned in the station the draft is of the utmost importance. The fine character of the fuel, as a result of which the particles pack closely together with but little intervening spaces, makes a forced draft imperative in order to secure the passage of the proper amount of air through the bed of fuel. The large grate area permits of the carrying of thin fires with a given total consumption of coal and the grates are designed to prevent loss by the dropping of fine coal through them. Whatever steam is needed in the draft to lessen the tendency to clinker is supplied from the exhaust steam mains so that economical results are obtained by this method of forced blast. Each boiler is in addition supplied with a steam jet blower discharging into the ash pits; but these are for reserve use only, as it is more economical to use the fan blower. A trestle about 150 ft. long and 13 ft. high with a suitable approach connects with the Delaware

& Hudson tracks and permits coal to be dumped from the cars into a bin extending the length of the boiler room and about 12 ft. from the doors of the furnace. The ashes are readily disposed of, being dumped in a pond about an acre in extent and 15 ft. deep just outside the boiler room door.

Fig. 2.—Exterior of Station, Showing Facilities for Receiving Coal and Disposing of Ashes.

Notwithstanding that the boiler room is very well lighted, the auxiliary apparatus, such as boiler feed pumps, forced draft apparatus, etc., is in the engine room directly in front of the switchboard, where an abundance of light is provided, and where the machinery will always be under the eye of the engineer. This practice is commendable and shows the thought bestowed by the engineers responsible for the design of the station. Too often does one find the boiler auxiliaries in an out-of-the-way corner of the boiler room, where the venerable dust of ages can accumulate on them, and where they usually receive the minimum of attention. This arrangement also worked out better in the general economy of space.

The boilers feed an 8-in. steam main running along the partition wall back of the boilers, 6-in.stop and check valves being provided at the boiler outlets and 6-in. gate valves at the main. Expansion is provided for in the steam line between the boilers and the main header by long radius bends. The 8-in. steam line to the engines runs down the partition wall and then passes under the engine room floor, coming up through the floor and joining the engine through a 3-ft. bend. A large receiver separator is provided in the engine room basement for each engine, and this is connected to one end of the tee from which the engine is fed. The exhaust line, which is 14 and 18 in. in diameter, runs along the basement floor, passing thence through a by-passed feed-water heater to the roof. Two Wainwright expansion joints are provided in the line. The auxiliaries are fed with steam taken from the main header through an auxiliary main, the feed water pumps being supplied through 1½-in. pipes, the steam-driven exciter through 3½-in. pipes and the fan blower through 2½-in. pipe line. The feed water is purchased from the city, since this is the only water available for feed purposes.

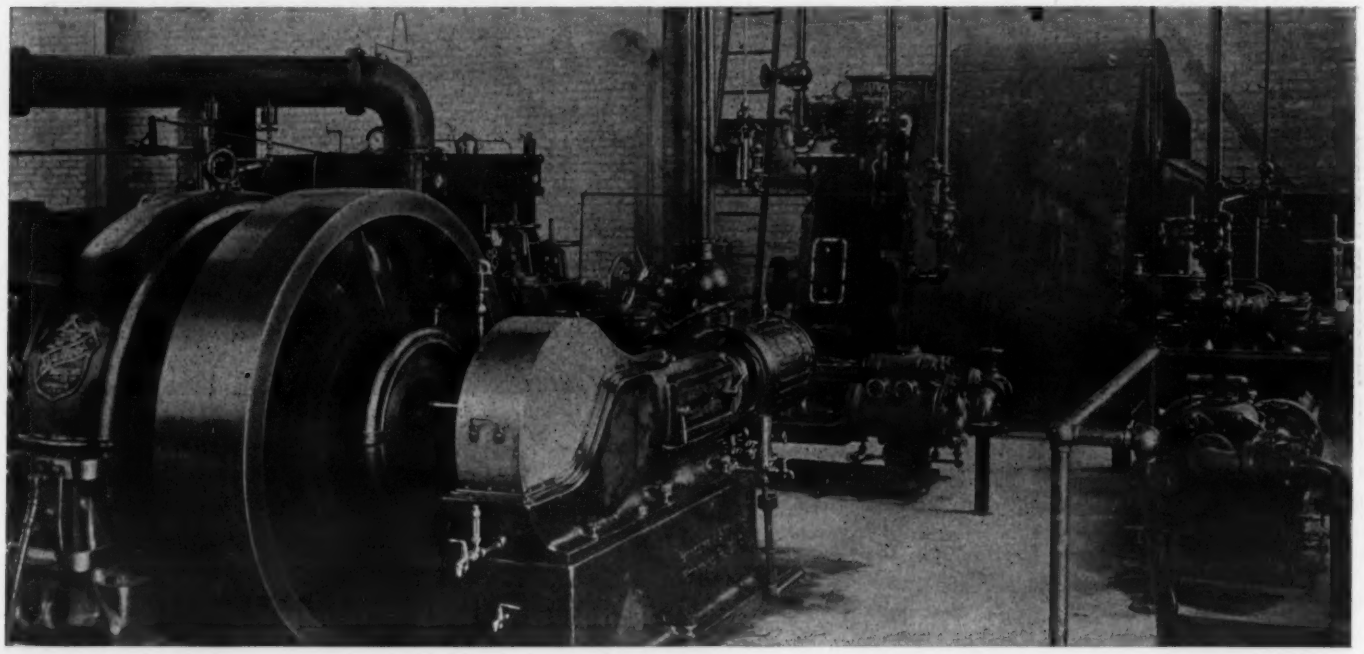


Fig. 3.—View of Auxiliaries in one Corner of Generator Room.

The main generating units are two in number and identical in character. Each consists of a cross-compound horizontal Corliss engine built in the Scranton works of the Allis-Chalmers Company, direct-connected to a Bullock alternator. The engines have cylinder dimensions of 18 and 36 by 42-in. stroke and are guaranteed to carry a continuous load of 1,000 hp. The alternators

deliver 60-cycle, three-phase current at a potential of 4,100 volts. Each alternator has its own exciter belt-driven from a pulley on the alternator shaft and delivering 160 amp. at a potential of 125 volts. There is in addition a 75-hp Fleming side-crank engine direct-connected to a 40-kw direct-current generator, which is used for exciter purposes. The steam pumps of which there are two are of Epping-Carpenter make 7½ by 5 by 10, and the fan blower for the forced draft system is of Sturtevant design driven by a vertical engine. All of the machinery is run non-condensing, because fuel is so cheap in the first place, and secondly, because water for condensing purposes would have to be purchased from the city. Scranton is in the heart of the anthracite coal region, and the Lackawanna River, which flows through the city, is not only very dirty, but contains so much sulphuric acid that the water is unfit for condensing purposes.

The switchboard is of Westinghouse design and contains six black slate panels, subdivided as shown in the illustration. There are two generator panels, one exciter panel, one regulating panel and two feeder panels. The three-phase, four-wire system of distribution is in use so that the convenience and economy in the secondary distribution systems due to this arrangement are obtained. From the station one pole line runs in a northerly direction serving the Green Ridge manufacturing district, and the other or main pole line runs southerly on Wyoming Avenue to the beginning of the underground district at Vine Street and Oakford Court. Tripartite iron poles are used throughout and the transmission line is about one mile long. The line to Green Ridge is of No. 6 hard-drawn copper and the two main lines running to the underground district are of No. 4 hard-drawn, weather-proof wire, one circuit being arranged on each side of the pole. From these service lines branch out in all directions.

Over $40,000 was expended in the underground system in the heart of the business section. Beginning at Vine Street and Oakford Court a twenty-duct underground conduit line runs south, branching east on Spruce Street and west on Center Street, and extending from Adams Avenue on the east to Main Avenue and Scranton Street on the west. Thirty miles of duct have been laid in the three miles of street opened. The underground system is sufficient to carry twice the existing lamp and motor load in the territory covered. A sub-station has been erected in the rear of the office of the company on Wyoming Avenue, in which there are two motor-generator sets for transforming alternating to direct current. Both alternating and direct current are carried in the underground system. The main feeders on the

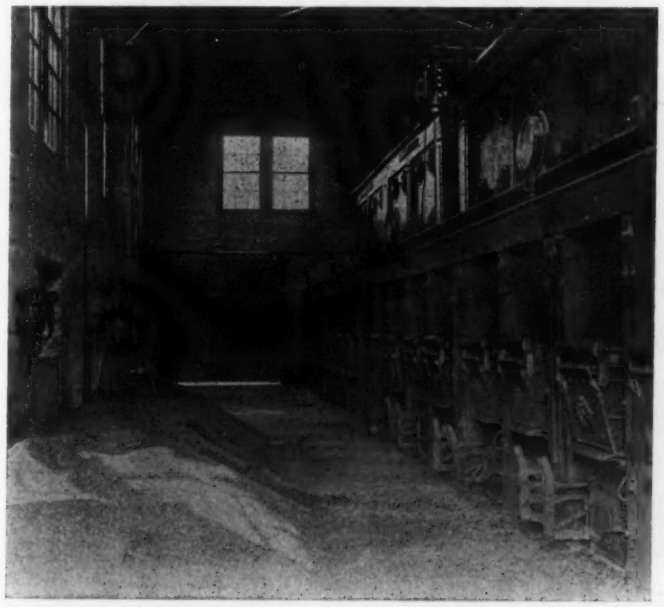


FIG. 4.—BOILER ROOM, LACKAWANNA LIGHT COMPANY.

alternating-current lines are a continuation of the overhead line and consist of two three-conductor No. 0 cable, feeding a three-phase system with grounded neutral, the sheathes being all bonded to the neutral. Manholes are provided at every corner, and where blocks are 500 ft. long two service manholes are provided between blocks. These are arranged so that not more than four customers are served from a service manhole. The latter are three feet square and take in the two top rows of ducts. These ducts carry the secondary circuits and the direct-current circuits. Transformers are placed in the manholes at street intersections,

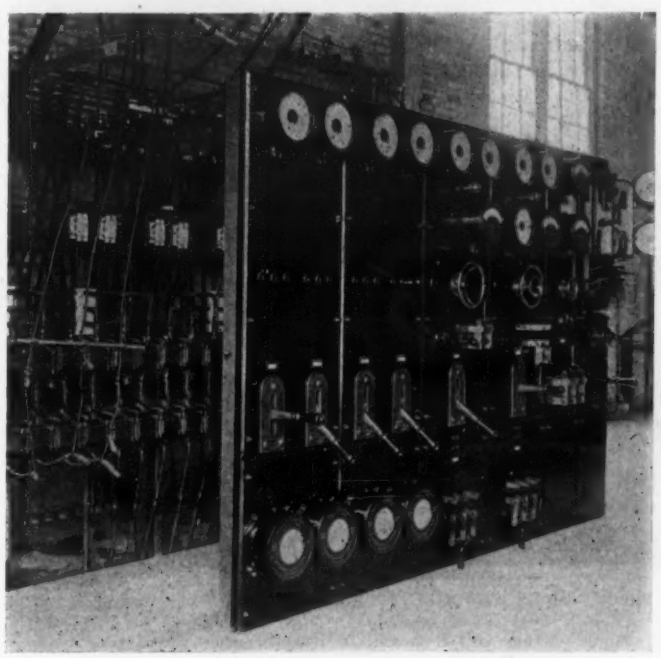


FIG. 5.—SWITCHBOARD, LACKAWANNA LIGHT COMPANY.

no transformer smaller than 10 kw and larger than 50 kw being used. The primary lines are in the ducts below the secondary lines and cannot be reached from the service manholes between streets. The secondary voltage is 220 three-wire and the current is carried in duplex cable with the middle tapped to a bare neutral. The bare neutral on the high-tension side and the bare neutral on the low-tension side are bonded together.

In the overhead district transformers of large size are used on the pole lines to supply customers. The heaviest motor load is on this line between the station and the underground district. Induction motors are used for the most part in the manufacturing plants connected to the system. By this means the company can furnish power to customers several miles from the station at a material saving to the company. Besides, the motors requiring a minimum of care are better adapted for the manufacturing plants served. The load in the underground district is mostly lighting, and often involves two service connections in the building, one direct current and the other alternating current, The direct current is used chiefly for motors and the sub-station provides 300 kw for this service. The load contracted for on the first of September averaged 1,500 kw, of which 500 kw is motor day load. With very few exceptions electricity is sold on a meter basis, the price for lamps being 10 cents per kw-hour for the first two hours and 8 cents after. The average price of electricity for motors is 6 cents per kw-hour. Both rates are subject to a discount of 10 per cent. Electric signs are put up free on a flat rate basis, and first installations and renewals of incandescent lamps are made free of charge. Westinghouse 6-amp. enclosed arc lamps are used on the system. It is the intention of the management to make the office of the company on Wyoming Avenue one of the most attractive spots in Scranton. Large electric signs will be installed together with flaming arc lamps and a complete display of electric cooking apparatus, fixtures, apparatus, etc.

The capitalization of the company is as follows: Capital stock, $400,000; first mortgage 5 per cent 30-year gold bonds, authorized, $500,000; issued, $300,000, the remainder being held in the treasury for extension to the plant. The officers are: Hon. J. W. Carpenter, president; J. Craig Havemeyer, vice-president; J. C. Keys, treasurer; G. H. Walbridge, manager; J. S. Avery, secretary, and Leon Colvin, chief engineer of the power plant.

The Lighting of Churches.

By J. R. Cravath and V. R. Lansingh.

THE lighting of churches is more difficult than that of theatres. It is even more important to keep light from shining in the eyes of the congregation in a church than in a theatre because in a church most of the lamps are turned on as long as the congregation is present. At the same time it is more difficult to conceal the sources of light because the usual church architecture makes it difficult. The old plan of lighting churches by means of immense clusters of lamps mounted on central chandeliers so that the light must fall directly in the eyes of all

FIG. 1.—FIFTH CHRISTIAN SCIENCE CHURCH, NEW YORK.

except those seated well forward in the audience must give way to some more hygienic, sensible and artistic method. To all persons but those with the strongest of eyes the facing of artificial light steadily through church services is uncomfortable and injurious, at the same time the usual forms of church architecture make the concealing of the lamps difficult.

Fig. 2 shows the lighting of the Second Presbyterian Church in Chicago. This is a most remarkable example of lighting and illustrates how far attempts at artistic lighting can be carried to the detriment of eyesight and of satisfactory lighting. The lighting fixtures which are certainly of original design have incandescent lamps placed upright in saucer-shaped devices. If the fixture were judged from a purely engineering standpoint one would imagine that the object aimed at was to throw as much light upward as possible. This latter result must have been fairly well secured because we note on a chandelier at the

FIG. 2.—SECOND PRESBYTERIAN CHURCH, CHICAGO.

extreme right that these saucers have been placed on top of the lamps to act as reflectors for throwing the light down. There is entirely too much light in the ordinary line of vision of persons in the body of this church. Not only are the lamps on the chandeliers in trying positions to those in the balcony, but the whole situation is made worse by the decorative lighting around the pulpit and organ, which must be looked at during the entire service by everyone in the congregation who makes any pretense to appearing attentive to what is going on. The lighting of galleries in this church should have been accomplished by lamps located back in the arches where they would be out of sight of as much of the congregation as possible. The lighting of the center of the main floor could be well accomplished by specially designed fixtures of the type shown later in Figs. 8 to 13, these fixtures being hung from the arches and arranged so that a person sitting behind would receive no more light than would shine through a very dense art glass. In other words,

FIG. 3.—FIRST CHRISTIAN SCIENCE CHURCH, CHICAGO.

persons in the audience should receive light from above and behind rather than from the front.

Fig. 3 shows the First Church of Christian Scientists, Chicago, which has an unusual architectural design and consequently permits of unsual church lighting arrangements. The lighting is done by lamps placed on the arches and around the central dome. Frosted lamps should always be used in such a case. The design of the lighting is fairly good from a hygienic standpoint, because but a small amount of light direct from the lamps enters the eye of most persons in the congregation. It would be better however, were deep reflectors used on the lamps on the arches, thus shading the lamps and increasing the amount of light thrown down. It would be desirable also to have designed the dome to permit of the lamps being pointed downward and placed in some common type of translucent reflector to direct the light down. In an audience room of such shape as this there appears to be

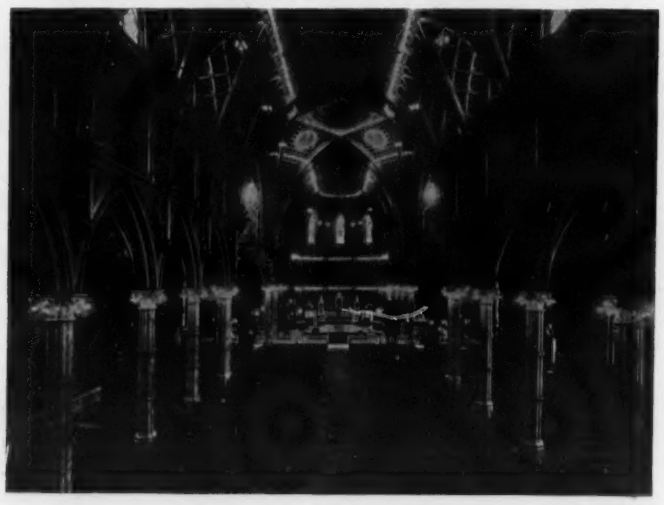


FIG. 4.—CHICAGO CATHEDRAL.

no opportunity for arranging lamps so that they will be entirely out of sight of more than two-thirds of the congregation. The only method of treatment is, therefore, to make liberal use of deep reflectors or diffusing globes.

Fig. 4 shows the lighting of a Chicago cathedral in which lamps are placed high up on the main arch and on the pillars. The pillar lighting is objectionable for reasons before emphasized. To much light shines into the eyes of the congregation

The same thing is true of the lighting of the altar. The lamps high on the arch are sufficiently above the range of ordinary vision to be unobjectionable. Lamps so located should have powerful concentrating reflectors in order to deliver as much light as possible down on the pews. In a church of this kind in which the pews all face one way it would be an easy matter to conceal most of the useful lighting behind the various features in the architecture so that it would not injure the eyes of those in the congregation.

Fig. 5 shows the lighting of a small church, this view being from the pulpit. This is not by any means to be taken as an example of model lighting, but is shown to give some ideas as to how lamps can be arranged so as to be out of sight of the congregation. The lighting as it stands represents simply a successful attempt to remodel with a small amount of money a very unsatisfactory previous arrangement. The principal lighting of this church auditorium was originally designed to be accomplished from the central basket form of chandelier seen. This basket was of copper wire gauze and had a number of bare incandescent lamps located inside of it. The copper wire gauze was designed to act as a diffusing covering, which it did to a certain extent but with an enormous loss of light. As it was necessary to increase the illumination without placing any more load on the circuits and necessitating the expense of rewiring, the following changes were made: The candle-power of lamps in the central chandelier was reduced one-third and the lamps were placed outside the basket and equipped with prismatic reflectors as seen in Fig. 5. This failed to bring up the illumination on the sides of the room sufficiently for comfortable reading. To accomplish this latter purpose the lamp shown between the beams at the extreme left was installed with a prismatic reflector; a corresponding lamp being placed on the other side of the audience room. At the pillars in the rear there was previously a lantern fixture covered with copper wire gauze, the absorption of which was not less than 50 per cent. The illumination in the rear of the

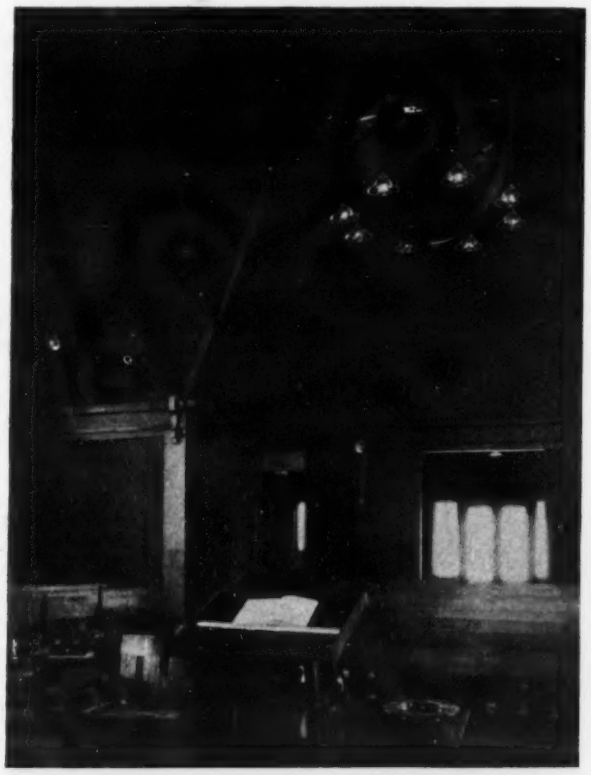


FIG. 5.—LIGHTING OF A SMALL CHURCH REMODELED.

room being entirely unsatisfactory, two lamps were placed in angle wall sockets pointing downward at an angle of 45 degrees and equipped with powerful prismatic reflectors so as to throw light from behind on those seated in the rear of the room. The result of these changes was to make the amount of illumination in all parts of the room fairly satisfactory. The central chandelier throws too much light in the eyes of those seated in the back part of the room and for this reason is objectionable. A larger proportion of the total lighting should be done from behind, leaving the chandelier to serve mainly a decorative purpose. Artistic ceiling fixtures placed on the walls or on the slope between beams could be used in place of the simple wall sockets shown in Fig. 5. Conditions as they stand could be improved by substituting for the reflectors used on the chandelier a deeper type of reflector which gives a wider distribution of light, such as shown in Fig. 1. This would hide the bare lamps from those seated in the rear seats so that they would receive only diffused

FIG. 6.—CHURCH WITH BARE GAS JETS.

light through the reflector and would cause the chandelier lamps to deliver more light to the sides of the room and less immediately under the chandelier than is now the case. Such reflectors were not available until after this work was done.

Fig. 1 shows another common method of church lighting also open to the general objection of too much light from the lamps shining in the eyes of persons in the congregation. As far as simple efficiency goes, the arrangement shown gives excellent results, the lamps on the chandeliers being equipped with concentrating types of prismatic reflectors which deliver a large percentage of the light down on the congregation. Frosted lamps should be used here.

Fig. 6 shows a church with bare gas jet brackets along the side walls and clusters of open flame burners over the organ

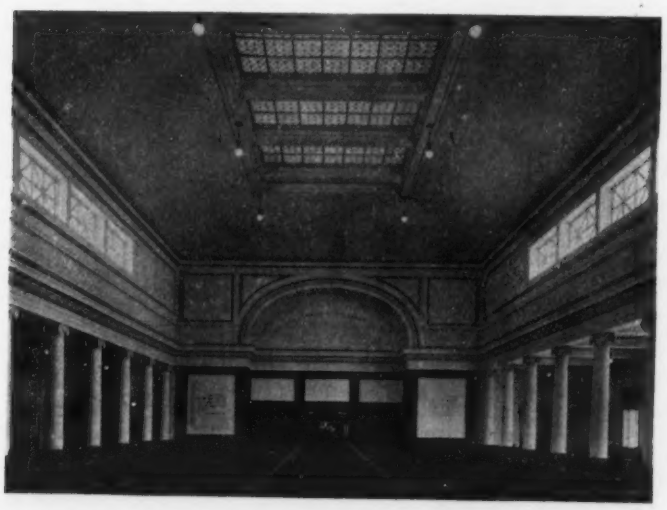


FIG. 7.—FIRST CHRISTIAN SCIENCE CHURCH, PITTSBURG.

and the choir. This is a good example of what to avoid as far as the lighting of the front of the church is concerned. The lamps there are placed where everybody must look directly at them during the entire length of the service. They are so situated as to be not only tiring to the eye, but owing to the eye working with a small aperture, the ability to see the preacher is materially decreased. A canvass among the congregation would doubtless disclose the fact that many people were subject

to headache when in the church, and that owing to the fact that it would be easier to close the eyes than to look at the light, people were put to sleep—not necessarily by the sermon.

Fig. 7 shows the interior of the First Church of Christian Scientists, Pittsburg, lighted by Nernst lamps hung high. Since the Nernst lamp, like an incandescent lamp with a reflector, throws so large a proportion of its light down, it is well suited to being hung high. Because the lamps are placed so high the lighting of this church is the least open to criticism of any of those shown. It is the best that can be done without concealing the lamps.

With ordinary fixtures there are only two methods of church lighting which represent even an attempt to avoid the very objectionable feature of light shining in the eyes of the congregation. One method is to conceal the lamps behind architectural features, such as beams and pillars in a way that the light will shine down and forward but cannot shine backwards so as to fall on the eyes. This method is good, but there are many churches or parts of churches where it cannot be done. Simply placing the lamps very high, while it is much better than having them low where they cannot be avoided by the eye, nevertheless is open to serious objection. As long as artificial light can fall steadily for some time on the eyeball, no matter from how high an angle, it will produce eye strain. The light must come from such an angle that the eyebrow shades the eyeball. This critical angle when a person is seated looking forward as in a church is about 25 degrees from a perpendicular drawn through the eyeball. To light a church well from a hygienic standpoint, then, we must have no rays of light shining backwards at an angle of more than 25 degrees from the perpendicular. The lighting must therefore be done by light shining down sidewise and forward toward the pulpit.

To accomplish this where the light cannot be shaded by architectural features or placed on back walls and ceiling slopes, a special design of fixture is necessary. Some suggestions along this line are given here to show the general principles which must govern the design of such fixtures.

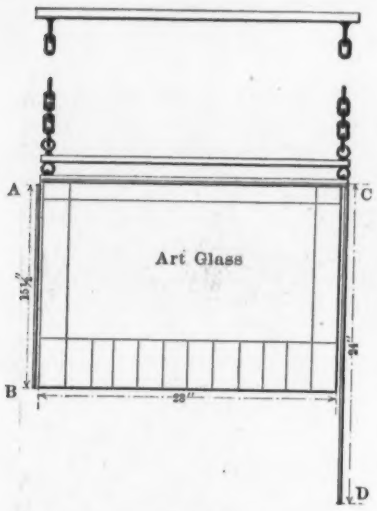


FIG. 8.—SIDE VIEW ART GLASS FIXTURE.

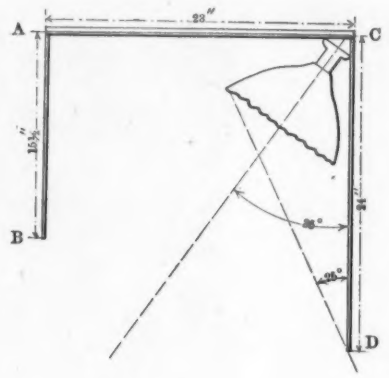


FIG. 9.—SECTIONAL SIDE VIEW OF CHURCH FIXTURE.

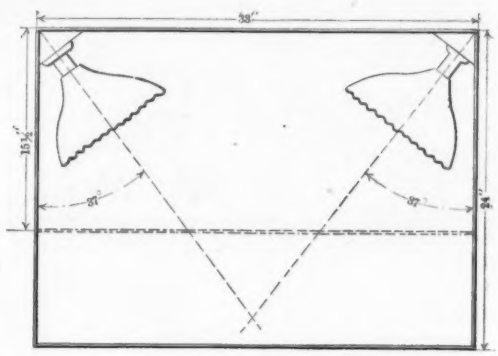


FIG. 10.—SECTIONAL REAR VIEW OF CHURCH FIXTURE.

Fig. 8 is a side view and Fig. 11 a rear view of a suggested form of fixture. In Fig. 8 the side *A B* is placed toward the pulpit and the side *C D* towards the congregation. It is made up in box form with the bottom open. The sides are art glass of any desired design. The side *C D* should be of very dense, nearly opaque glass, since this is the side which sets as a shield to protect the eyes of the congregation seated behind it. The other sides need not be as dense unless uniformity for the sake of appearance is wanted, and that is mainly a matter of taste. A sectional side view of this fixture is seen in Fig. 9, which shows the arrangement of one of the lamp sockets and reflectors as viewed from the side. Fig. 10 is a sectional view from the rear showing both of the lamp sockets and reflectors as they would appear from the rear if the art glass of the side *C D* were removed. The reflector selected should preferably be a fairly concentrating type of prismatic reflector. This fixture is designed for two lamps of 32 or 50 cp each. The reflectors are pointed so as to throw the light forward and sidewise. The side *C D* keeps the light from shining backward at more than the

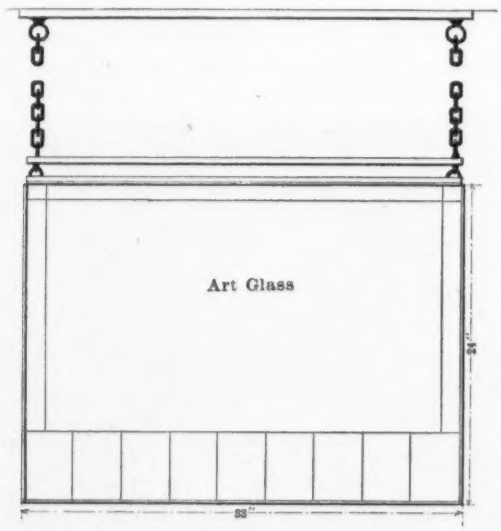


FIG. 11.—REAR VIEW OF ART GLASS FIXTURE FOR CHURCH LIGHTING.

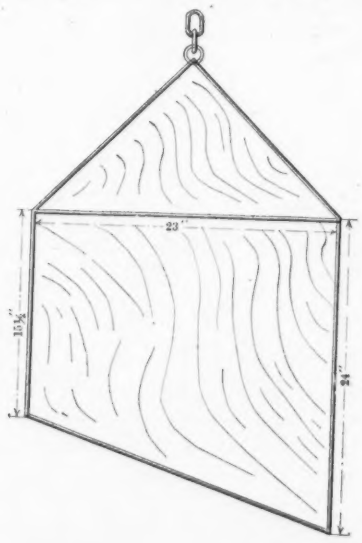


FIG. 12.—CHURCH FIXTURE IN LANTERN DESIGN, SIDE VIEW.

critical angle of 25 degrees except the little going through the dense art glass. The side *A B* and those joining it are made shorter so as not to interfere with the light thrown forward and sidewise. In order to accomplish the shading and avoid excessive height of the side *C D* the lamps should be placed close to this side as shown. The dimensions are given on the drawings. This is as small as the fixture should be made for two 32-cp lamps because if the side *C D* is made less than 24 inches, it will not shade the eyes from the lamps if allowances are made for ordinary inaccuracies of manufacture in such goods. It can, of course, be made as much larger as seems desirable. This fixture with proper reflectors will light an area extending forward toward the pulpit, a distance approximately equal to the height of the fixture from the floor and double that distance sidewise. There is room for a third lamp without increasing the width. It is, generally speaking, advisable to hang these fixtures rather low and use a number of them to cover this area to be lighted rather than to place a few large fixtures high up.

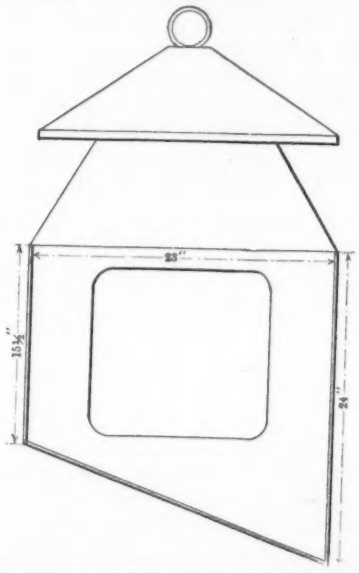


FIG. 13.—CHURCH FIXTURE IN LANTERN DESIGN, SIDE VIEW.

There is a great gain in economy of light by hanging them low, since the intensity of light on the pews varies inversely as the square of the distance of the fixtures above them. The usual objection to low chandeliers (that the light is brought too nearly in the line of vision) does not hold here because of the shading effect of the dense art glass backs of these fixtures.

The same principle can be carried out in other designs, but only two others will be shown here. The lantern design lends itself well to the carrying out of this principle as shown in Fig. 12, which is a very plain lantern design and also in Fig. 13, which is more elaborate.

Abnormal Operating Conditions of Electrical Apparatus.

BY A. E. BUCHENBERG.

NUMEROUS investigations and tests covering apparatus reported by the purchaser as unsatisfactory on account of excessive heating or inability to carry rated load, have demonstrated the fact that the importance of operating electrical apparatus under normal conditions is not fully appreciated by central station men. The writer has encountered instances where alternators were being operated at 20 per cent below rated speed at full load, and others where the voltage was carried 25 per cent high at the peak of the load to compensate for excessive line drop. In one case the alternator voltage was being carried 18 per cent high on the switchboard instrument which was reading 11 per cent low. The inaccuracy of the switchboard voltmeter was in this instance due to the fact that several incandescent lamps were connected with the voltmeter across the secondary of a 60-watt instrument transformer. The above are, of course, extreme cases, but there are numerous plants, especially among the smaller installations, where the electrical apparatus is not operated under normal speed and voltage conditions. The present article is prepared for the interest and the information of central station men and attendants, and all mathematical analyses, formulæ, and calculations are omitted, results only being given.

Practically all electrical apparatus is now "standardized"; that is, it conforms to certain standard conditions covering speed, voltage, frequency, etc., and all apparatus has a fixed guaranteed performance under normal operating conditions. The above guarantees usually cover capacity, heating, efficiency and regulation; any change from the specified operating conditions causes a corresponding change of electrical and mechanical interactions, which may cause a great deviation from the manufacturers' guarantees.

The individual characteristics of the apparatus must be known in every case in order to obtain actual results, but in the present article we will confine ourselves to relative quantities and amounts. Before entering into details of the several factors affecting the operation of the apparatus we will take up in general the several energy losses which are of vital interest to the central station man from the fact that they directly affect the efficiency of the electrical apparatus, and consequently the economy of the entire installation.

Iron Losses.—The total iron losses are composed of the hysteresis loss, which represents the power consumed in subjecting the iron to alternating magnetic influence, and the eddy-current loss, which is the power consumed due to the setting up of induced currents of electricity in the iron itself. The hysteresis loss depends upon the quality of the iron, the magnetic density, and the frequency; while the eddy current loss depends upon the thickness of the laminations forming the active iron structure, the electrical conductivity of the iron, and the frequency. As we are dealing with apparatus in operation, all of the above elements with the exception of frequency and magnetic density are fixed. At commercial frequencies and with modern construction, the eddy current loss is the smaller of the two, and varies from 45 per cent of the combined losses at 133 cycles, to 15 per cent at 25 cycles. The variation of the iron losses with frequency and voltage will affect the all day as well as the full load efficiency of the apparatus, since they continue during the entire period of operation of the plant.

Copper Losses.—The copper loss is caused by the flow of current against the electrical resistance of the conductors forming the windings, and varies as the square of the current and directly as the resistance. The increase of temperature due to copper loss has a decided influence upon the regulation of alternators and transformers, and consequently upon the life, efficiency, and satisfactory service of incandescent lamps, and the proper operation of induction motors.

Windage and Friction Losses.—These losses are obviously present in generators and motors only, and combined vary approximately as the square of the speed. A considerable portion of the windage losses are indirectly utilized in affording efficient ventilation of the windings and active iron of generators and motors, and a variation of speed will therefore affect the operating temperatures.

Temperature Rise.—The iron and copper losses are manifested in the form of heat, which must be dissipated by radiation and conduction. A low temperature rise is very desirable from the fact that insulating materials slowly deteriorate even at comparatively low temperatures, and to a great extent lose their insulating properties. When subjected to excessive temperatures they soon become a constant menace to the satisfactory operation and life of the apparatus. "Aging" of iron, or the increase of iron losses caused by the so-called magnetic fatigue, can undoubtedly be caused by very moderate temperatures, and an increase of from 25 to 45 per cent is to be expected ultimately when the apparatus is operating much above the normal temperature. Excessive iron temperatures will, by the conduction of heat, increase the temperature of armature coils or transformer winding, and seriously affect the regulation of the apparatus.

ALTERNATORS.

Lowering the Frequency.—The operation of an alternator below the speed corresponding to the rated frequency, and at rated voltage, increases the iron losses on account of the higher magnetic induction necessary to generate this voltage. The copper

loss in the field coils is higher, due to the additional exciting current required to force the increase of flux through the iron. For a decrease of 10 per cent in speed under the above conditions the iron loss will be 15 per cent higher, while the copper loss in the field coils will be greatly increased. The poorer ventilation resulting from the reduced speed allows excessive temperature rises, and the output of the machine is limited to a value below the rated capacity on account of magnetic saturation and heating. The efficiency at all loads is greatly impaired.

Increasing the Frequency.—An increase of operating speed above normal reduces the iron losses on account of the lower magnetic density and exciting current, and in addition the ventilation is improved. The windage and friction losses are increased and the mechanical factor of safety reduced, with a slightly impaired regulation. For normal heating conditions the available capacity of the machine is increased while the efficiency at normal load is not appreciably changed.

Table I, abstracted from tests on a small 2,300-volt standard alternator, will afford an idea of the changes of field excitation with changes in speed, the normal speed being 600 r.p.m.:

Table I.

Speed in R.P.M.	Alternator volts.	Field amperes.	Field volts.	Watts field excitation.
500	2300	11.0	174	1914.0
525	2300	7.7	116	893.2
550	2300	6.4	99	633.6
575	2300	6.0	92	552.0
600	2300	5.5	84	462.0
625	2300	5.1	78	397.4
650	2300	4.8	72	345.6

Lowering the Voltage.—The operation of an alternator at rated speed and kilovolt-ampere output, with decreased voltage will lower the iron losses and the copper loss in the field coils, and increase the copper loss in the armature coils. With a decrease of 10 per cent in voltage the regulation will be slightly impaired while the efficiency remains practically the same. The available output is in this case limited principally by the temperature of the armature copper, which is favorably located for the rapid dissipation of heat.

Increasing the Voltage.—For reasons affecting the machine regulation, and economy of material, the active iron of modern alternators is worked at or near the "knee" of the saturation curve. The higher magnetic density rendered necessary for voltages above normal entails a rapid increase of exciting current. The iron losses are larger, and these, with the serious increase of field excitation, limit the available capacity of the machine at a point considerably below the rated kilovolt-ampere output, while the reduced efficiency at all loads is an important consideration in economical plant operation.

Table II, from tests on a 2,300-volt, 600-r.p.m. alternator, will show the rapid increase of excitation for voltages above normal:

Table II.

Alternator volts.	Field amperes.	Field volts.	Watts field excitation.	Speed in R.P.M.
2200	4.8	72	345.6	600
2300	5.5	84	462.0	600
2400	6.4	98	627.2	600
2500	7.7	116	893.2	600
2600	9.5	149	1415.5	600
2700	11.5	182	2093.0	600

TRANSFORMERS.

Lowering the Frequency.—A lower frequency will result in increased hysteresis loss and higher temperatures in the transformer iron. Reducing the frequency from 133 to 125 cycles will entail an increased hysteresis loss of 4 per cent, and a reduction from 60 to 50 cycles will raise the hysteresis loss approximately 10 per cent. A reduction of 20 per cent in the frequency will increase the transformer exciting current 14 per cent. For the same output there will be no change in the secondary copper loss, but in the case of line transformers the higher temperatures due to excessive iron losses will materially decrease the safe output, and the normal rated secondary current now becomes a virtual overload on account of the deterioration of insulating materials. Increased iron losses and exciting current, in addition to decreased load capacity mean also greater coal consumption, all factors being directly opposed to economical plant operation.

Increasing the Frequency.—An increase of 10 per cent above normal frequency at the rated e.m.f. will lower the iron losses by nearly 18 per cent, while the exciting current will be correspondingly decreased. For normal temperature rise the secondary current can be larger, thus affording a greater available transformer output, and an increased all day plant efficiency due to the smaller iron losses.

Lowering the Voltage.—The operation of transformers at voltages below normal at rated frequency will lower the iron losses on account of the smaller magnetic induction, but will increase the copper loss, assuming the kilovolt-ampere output as equal to the rated capacity. A decrease of 10 per cent in voltage will lower the iron losses by 15 per cent, while the copper loss will be 18 per cent higher. A greater decrease in voltage will entail an excessive temperature rise in the copper and make the operation of the transformer unsafe, or for the normal temperature rise will reduce the available capacity.

Increasing the Voltage.—The capacity of a transformer is greatly lowered, assuming a resultant safe temperature rise, when the voltage across the primary terminals is increased by the frequency being normal. An increase of 10 per cent above normal will raise the iron losses by nearly 20 per cent, while a rise of 20 per cent will increase these losses by nearly 38 per cent. When operating transformers with a primary voltage above normal there is a reduction in the insulation factor of safety, and in addition to the decreased capacity, increased iron losses. This considerable increase of iron loss being present from the starting up to the shutting down of the plant is a particularly serious element in the lowering of the plant efficiency.

INDUCTION MOTORS.

Lowering the Frequency.—With a decrease in frequency of 20 per cent, the voltage being normal, the iron losses are 18 per cent higher, while the friction and windage losses are 25 per cent less. The power factor will be decreased by approximately 1.5 per cent, and the efficiency will be 1 per cent less.

Increasing the Frequency.—Up to 10 per cent increase in frequency at normal voltage the operation of induction motors is very satisfactory. The total efficiency remains practically unchanged while the starting torque is reduced 10 per cent, and the power factor is improved 1 per cent. At higher frequencies trouble is encountered where the starting load is heavy, on account of the smaller starting torque.

Reducing the Voltage.—With a reduction of 10 per cent from the normal voltage, at normal frequency, and with rated output, there is a decrease of 15 per cent in the iron losses, while the friction and windage losses remain unchanged. The total copper loss is increased by 20 per cent, and the power factor by 1 per cent, while the starting torque becomes 15 per cent less. For greater voltage reductions the efficiency and starting torque rapidly decrease and the copper loss becomes excessive.

Increasing the Voltage.—The iron losses will be about 18 per cent higher for a 10 per cent increase in voltage, while for the same output the copper loss will be smaller, and at full load the efficiency will not be materially changed. Below full load the efficiency is rapidly reduced with increase in voltage, and the power factor is reduced, as is also the insulation factor of safety, from the fact that both voltage and temperature are increased.

SUMMARY.

It follows from the foregoing that operating difficulties and disadvantages follow any deviation from normal operating conditions, and every effort should be made by the station man to fulfill exactly the manufacturer's stipulation covering the use of his product. Such compliance not only affords him the highest possible operating economy, but is also conducive to pleasant business relations.

Only comparative results have been given, but the percentages shown are approximately correct. The actual losses for any particular piece of apparatus, under normal operating conditions will be gladly furnished by the manufacturer upon request.

Insufficient copper in the line, deficiency in engine capacity, poor engine regulation, and incorrect switchboard instruments, are the common causes leading to the above abnormal operating conditions; and a calculation of the actual increase of losses entailed will in many cases show a gain above interest and depreciation charges on the investment necessary to correct the evil.

Papers and Discussions at the Illinois Electrical Convention.

Following are abstracts of the principal papers presented at the meeting, September 19 and 20, at Springfield, O., of the Illinois State Electrical Association, together with the discussions thereon:

ELECTRIC METERS.

Mr. Robert W. Lamphere, of Springfield, O., after sketching the development of electric meters, described the different types now in use. He said that a few years ago it was generally regarded by central station men that the increased revenue to be gained by the use of electric meters was not sufficient to justify their installation. At the present time, however, the tendency is to install meters and to get away from flat rates. He added that no flat rate was fair to all customers. Meter rates, however, were fair to all concerned. A complete installation of station meters and meters for customers gave the best possible check on transformer losses.

He divided meters into three general classes: Motor meters, electrolytic meters and fluid-expansion meters. After giving in a very clear manner the essential principles of the induction meter, he gave what he considered the requisites of good meters. Meters should be dust and bug proof; they should be protected from lightning; they should be accurate on reasonable variations in voltage, temperature and frequency, and they should be accurate on very light loads. He thought approximate tests should be made by central station men on meters received from the factory. Such tests could usually be made with a suitable bank of lamps together with a voltmeter and a meter which was known to be accurate.

CENTRAL STATION ACCOUNTING.

In a paper entitled "System of Accounting from a Moderate Sized Plant," Mr. W. J. Achelpohl, of Galesburg, Ill., urged that the office manager or accountant have a thorough knowledge of all the details of the plant and that he be in close touch with the management for otherwise he would not be able to devise systems of report-making and record-keeping. Unless the accountant has a clear understanding of the conditions of the plant his reports may be valueless and may probably be misleading and those depending on his reports as a consequence may be entirely in ignorance of the true conditions of the plant. A good accountant should be able to detect leaks in the management, excessive costs of maintaining any department, and by a comparative study of past records be able to tell at once if any part of the plant is being neglected. The greater portion of Mr. Achelpohl's paper was devoted to an outline of the system of accounting of the Galesburg Railway & Light Company. The different forms and blanks used were shown in connection with the description.

The reading of Mr. Achelpohl's paper was followed by an animated discussion regarding the forms of cash vouchers and methods of paying accounts. In this discussion Mr. Achelpohl, Mr. J. N. C. Shumway, of Taylorville, and Mr. Fred W. Insull, of Oak Park, were principals. Mr. Shumway wanted to know if Mr. Achelpohl had ever seen any reason for desiring to change the form of his cash voucher to a single sheet of paper instead of a folded one. He added that he was using a folded voucher, but the banks objected to this form and that the voucher would be changed to a single sheet. Mr. Achelpohl explained that the voucher in use by him was so arranged that it was not necessary to unfold it in order to find out the amount for which it was drawn.

STATION OPERATION.

Mr. Charles E. Sharpe, of Molino, Ill., presented a paper dealing with station operation. To secure the best results with a modern station Mr. Sharpe thought the feed water should first be examined as this might contain some substance that could be eliminated or neutralized. The coal should then be analyzed. He had found that the cheapest coal was not always the most economical. An analysis alone should not be depended upon, but the coal should be tested by burning it under the boilers. The fuel gases should also be given attention. Recording charts should be put in every available place. The engines should be operated so that each will carry its most economical load. Daily reports of consumption of coal, water, if purchased, oil waste and other supplies should be kept. The cost of production per kw-hour should be figured daily and comparisons of results should be made from day to day. Comparisons should also be made with results obtained at other stations. Meters, and particularly direct-current meters, should be tested regularly. At frequent intervals the total readings of consumers' meters should be compared with the readings of the switchboard meters to check losses between the station and the consumers.

Mr. Sharpe thought it of great advantage to a company to furnish its customers with free lamp renewals. The best lamps should be supplied, as with these there were a less number of complaints from customers. When the customer furnishes his own lamps he is apt to be controlled by the cost of the lamps and purchase lamps which require a large amount of current and which give poor results.

The average company failed to appreciate the benefits of persistent advertising. He thought newspaper advertising the most profitable, but recommended other kinds, and among them, demonstrations in cooking. The company should have a soliciting department and probably it would be better for the company to wire houses and do it without profit to itself. He did not believe in securing customers in outlying districts, as the line losses in supplying these with current were usually very heavy. To build up power loads he thought motors should be furnished at cost. Mr. Sharpe wanted to know what was the largest size of single-phase motor that should be put on lighting circuits. He said he had found some using as high as 15-hp motors on these circuits.

The offices of lighting companies should be in the most central part of the business section. In concluding he urged that a uniform system of accounting be adopted for lighting companies. Without such a system he said it was absolutely impossible to make comparisons of the costs with other stations.

In reply to Mr. Sharpe's inquiry concerning single-phase motors Mr. R. S. Wallace, superintendent and chief engineer of the Peoria Gas Light & Coke Company, said the size of single-phase motor that could be operated on lighting circuits without inconvenience depended on the kind of service. His company operated motors as large as 5 hp. He added that a 3-hp motor would sometimes cause a variation of from two to three per cent in the voltage. Mr. Lukes thought a 5-hp motor a good limit. He thought the service on the motor should be considered. If the motor were started but once a day or if it were provided with a clutch or a loose pulley for starting a larger size could be used. Mr. Frey did not think it good policy to put single-phase motors on lighting circuits.

Mr. Gerlach, of the Wagner Electric Company, St. Louis, said that in Belleville, Ill., single-phase motors up to 25 and 30-hp were supplied from lighting circuits. The companies there were discontinuing the use of direct-current motors and were adopting those of the alternating-current type.

With regard to prices charged for power in Belleville, he said 6 cents per kw-hour was the basis, and from this as high as a 50 per cent reduction was made, the reductions varying with the quantity used.

The discussion on single-phase motors led to the question of the comparison of rates of other stations as a basis for making power and lighting rates.

Mr. McDonald, of Lincoln, said he had gathered figures from other plants and that on classifying them he had found they were controlled to a great extent by the price of coal. Mr. Schmidt thought it well to gather data regarding the prices charged by other plants, as a prospective customer could often be satisfied by showing him what other companies were charging. He suggested a committee be appointed to gather prices for the use of members of the association. Mr. E. B. Hillman, of Quincy, said he had concluded that such a committee would not be able to get the rates unless it sent a man to each station, as managers were usually averse to giving out their lowest rates. He thought the cost of coal could be obtained without trouble.

Mr. W. J. Austin, manager of the Effingham Electric Light & Power Company, gave the results of the operation of two 120-hp Diesel engines. Each of the engines is direct-connected to a Fort Wayne, two-phase, 60-cycle, 2,200-volt, 85-kw generator. The guaranteed fuel consumption of the engines is 12½ gallons of oil per 100 kw-hour at from 50 per cent load to full load. In the plant at Effingham the switchboard is equipped with integrating wattmeters and readings are taken hourly. The fuel consumption is 15½ gallons of oil per 100 kw-hour on a 24-hour run with a load varying from 12 per cent to 85 per cent of full load, the average being 23 per cent. With oil at 3.4 cents per gallon this gives an average cost of .542 cents per kw-hour. Of several tests that have been made the lowest cost of fuel obtained was on a 6-hour test at an average load of 70 per cent. On this test 11.3 gallons of oil were consumed per 100 kw-hour and the cost of the fuel was .384 cents per kw-hour.

With regard to regulation Mr. Austin said that the two alternators are operated in parallel and that there is scarcely ever a noticeable variation in the lights. Speed regulation is maintained by a governor pump which delivers just enough oil to the cylinder to keep the speed constant. The engines are started by air and usually about two minutes are required for one man to start an engine. The crank cases of the engines are enclosed and are filled with oil. From six to eight quarts of lubricating oil are required every 24 hours.

Regarding the space required for the engines, Mr. Austin said the building in which the plant is enclosed measures 48 ft. long, 32 ft. wide and 12 ft. high, and that there is room enough in the building for two more engines. The cooling water is circulated by a rotary pump driven by a single-phase motor. In winter the water is cooled by sending it through 1,000 ft. of two-inch pipe placed around the walls of the building. The radiation from these pipes is sufficient to heat the building except in zero weather. In conclusion Mr. Austin said he was not prepared to state what the cost of repairs on the engines would be, as they had been in operation only about eight months.

The discussion of Mr. Austin's paper was opened by Mr. Emil G. Schmidt, of Springfield, who wanted to know if the figures given for the cost per kw-hour were for fuel alone, and also what was the relative cost of ordinary steam plants and oil engine plants. Mr. Austin, in reply, stated that the cost figures given were for fuel alone. When they were figuring on their plant, he said, the price quoted them for a complete and up-to-date steam plant was practically the same as was the cost of the oil engine plant.

John F. Gilchrist, of the Chicago Edison Company, wanted to know what in Mr. Austin's opinion had prevented more rapid progress in the use of oil engines. He asked if the city authorities objected to the storage of large quantities of oil. He said he understood the question of the storage of oil was influential in preventing the installation of oil engines in the White City in Chicago.

Mr. Austin stated in reply that no trouble had been experienced with the question of oil storage. The Underwriters inspected the plant and gave the company an insurance rate of about $1.48. Later some changes were made and the rate was reduced to about 78 cents. Reasons for the engines not being generally adopted he thought were their cost as compared with steam engines, the fact that they had not been thoroughly developed until a few years ago and the slowness with which anything radically new is taken up. He thought that at the present time the engines were being rapidly adopted and mentioned some recent orders for engines.

Some doubt was expressed by members as to the reliability of the engines and Mr. Austin was asked how many times defective operation of the engines had caused his plant to be shut down. In reply Mr. Austin said the engines were put in operation February 15, 1906, and that the plant has been operated 24 hours a day, exclusive of Sundays, since that time. One engine is required to carry the load except on the peak, when both are required. During the time they have been in operation the engines, Mr. Austin said, had not occasioned a shut-down of the plant. He stated further that the engines are operated by the help that formerly ran the old steam plant. The plant is operated 24 hours a day by three men on shifts of about 10 hours each. These men are paid about $50 per month. He added that he is using Kansas and Oklahoma crude oil, which he obtains from the Standard Oil Company on a contract at 3.4 cents per gallon. Effingham, Ill., the location of the plant, however, is in the Illinois oil field and independent oil operators have offered to sell him oil at the same price for which he is at present getting it.

Throughout Mr. Austin's remarks he emphasized the fact that the oil engines require more careful attention than is necessary for steam engines. The attendant must not leave them alone for any considerable length of time, but must make frequent inspections.

Papers and Discussions at the Colorado Convention.

Following are abstracts of some of the discussions and papers at the convention of the Colorado Electric Light, Power and Railway Association, held at Denver, September 18, 19 and 20, 1906:

TRANSFORMER TESTING AND LINE RECORDS.

Mr. E. P. Dillon, acting manager of the Colorado Springs Electric Company, presented a paper on "Transformer Testing and Line Records for Transformers," in which he described the tests he considered should be made on new transformers as received from the factory and the records used in keeping track of transformer locations and loads after they have been placed on the lines.

The first thing to be considered is public liability, so that the insulation of a transformer about to be put on the line should be tested between primary and secondary, between primary and case and between secondary and case. He tests 2,300-volt primary coils with 10,000 volts. The secondary is tested with 2,300 volts between coil and case. For obtaining 10,000 volts transformers are connected with primaries in series and secondaries in parallel fed from a low-tension secondary circuit. A liquid rheostat consisting of fruit jars containing dilute sulphuric acid is used to cut down the current supply at first and gradually raise the voltage to the full 10,000-volt test pressure. To test the core loss which goes on continuously while the transformer is in service, the secondary of the transformer is connected to a live secondary circuit through a wattmeter. The wattmeter will indicate the core loss. This test should be made from the same generator or current supply as that ordinarily supplying the lines, as the core loss is dependent on the wave form of the source of supply. The copper or I^2R loss is found by putting direct current through the coils and measuring the resistance with voltmeter and ammeter. He then took up a system of records of transformers connected to a system. A map of each section of the town is kept on tracing cloth. This shows the lines and transformers. When changes of lines are made it is easier to trace a new map with the aid of the old than to correct an old map. He showed a form of transformer record card and also a consumer's card.

In the discussion, replying to a question as to what percentage of the connected load was taken as the proper capacity for the transformer, Mr. Dillon said that in residence districts transformers were of a capacity equal to 25 per cent of the connected load. In commercial districts the percentage was 80 or 90. In Colorado Springs few secondary mains are connected to more than one transformer. Three-wire secondaries are grounded. The load on down-town transformers with many customers is occasionally tested with a maximum demand meter. It is easier to determine the maximum load on the transformer in this way by actual measurement when 50 to 100 customers are on a transformer than to obtain the information by estimate from the numerous customers' cards.

ILLUMINATING ENGINEERING.

The most of one session was given over to illuminating engineering. Mr. J. R. Cravath, of Chicago, Western editor of the Electrical World, presented a paper on the lighting of small stores, an abstract of which is printed elsewhere. Following the paper by Mr. Cravath, Mr. W. D'A. Ryan, of West Lynn,

Mass., illuminating engineer of the General Electric Company, gave a talk on the illumination of a class of larger stores with special reference to arc lighting. His remarks applied specially to stores over 25 ft. wide, lighted by large units rather than the smallest stores where, as indicated by the previous paper, small units gave better results. In a large store Mr. Ryan indicated that a large number of small units was objectionable because of the large number of outlets. Before going into the specific problem of store lighting he made some general remarks on efficiency and color. He called attention to the misleading ratings often applied to lamps, and stated that contrary to general belief the initial efficiency of the alternating and direct-current arcs in watts per mean spherical candle-power is about the same. The difference is mainly in the distribution of light from the arc which could be largely connected by properly shaped reflectors of sufficient size. Stated roughly, an arc lamp consumes from 2 to 3 watts per mean spherical candle-power, when tested with a light opal inner globe. The higher efficiency represents the commercial arcs of largest amperage, the lower the small arcs. The Nernst lamp, he stated, consumes 3.78 watts per mean spherical candle-power. A common incandescent rated as a 3.5-watt lamp takes 4.24 watts per mean spherical candle-power when new. In actual practice the incandescent will range from 4.5 to 5.5 watts per mean spherical candle-power.

He then described the various devices he had designed to utilize and reflect downward the upward rays from the arc lamp, which are usually wasted. The upturned concentric diffuser put on the market several years ago, while proving excellent for giving diffused light, is a refinement somewhat in advance of the times and has been largely supplanted by a later type of down-turned concentric diffuser, which is a corrugated reflector 39 in. in diameter used over the ordinary standard opal outer arc lamp globe. He then described his light-balancing selective diffuser ceiling which consists of a reflecting surface of proper shape to give reflections which will compensate for the wandering of the arc around the carbon tips, as well as utilize the upward light. This surface forms a part of the ceiling. He said the day would come when users of light would cease to consider questions of candle-power and efficiency of illuminants and would take instead guarantees of a certain amount of light to be delivered on the working level. In reply to a question, Mr. Ryan said the opal globe and the Austrian zinc-white used for the reflecting surface of his ceiling absorbed violet rays, thus whitening the light. In answer to a question as to the place the flaming arc will probably take, he said it was unsuited to indoor illumination because of its unsteadiness and fumes. The General Electric magnetite luminous arc he considered to be the coming street lamp unless something better comes up to supplant it.

CHANGE FROM DIRECT TO POLYPHASE POWER DISTRIBUTION.

Mr. W. A. Carter, of the engineering staff of the Denver Gas & Electric Company, described the change made by that company from direct to alternating-current power distribution in territories just outside of the business district. As described in the ELECTRICAL WORLD AND ENGINEER of June 3, 1905, the company had for motor service a 220 and 440-volt, three-wire, direct-current power distribution, most of the energy being used in and near the down-town district. The lighting distribution of the whole city is by single-phase feeder lines supplied from three-phase bus-bars at the power station. Mr. Carter explained in his paper that the direct-current motor feeders were getting so long and the distant customers so large that an excessive amount of copper was called for. For example, on one loaded feeder 1½ miles long a contract was taken for a 300-hp motor. The decision was made to change the motor service outside of the down-town district to three-phase, and to give customers new three-phase induction motors in place of their direct-current motors. Most of the direct-current motors were sold at good prices. The direct-current copper taken down was worth enough to reduce materially the cost of the change. One puzzling question was to decide whether to use 220 or 440-volt motors. With 220-volt motors but one customer could usually be supplied from a bank of transformers, whereas with 440-volt motors and secondaries several in one locality could be supplied. The latter advantage was considered to be more than counterbalanced by the fact that with 220-volt motors standard lighting transformers could be used. The change was made without interrupting customers' service. All future extensions of the power distribution system will be polyphase. Some customers were suspicious of the offer to give them a new motor in exchange for the old. They thought the new motor might be inferior or that it might be some scheme to make electricity cost them more. When it was explained to them there was no difficulty.

STEAM TURBINES.

Mr. C. C. Chapelle, of the Westinghouse Machine Company, Denver, presented a paper on steam turbines, with especial reference to the Westinghouse-Parsons type. A summary of the immense business in turbines at the present time shows how well it is fulfilling the predictions made for it as a prime-mover. In an extended discussion of turbine economy he pointed to the fact that while a good compound condensing steam engine when under test conditions might show an economy equal to a turbine, the steam engine in actual service is much more likely to get leaky or out of adjustment than the turbine, so that the practical working efficiency of the latter is likely to be higher than that of the engine. The simplicity of the turbine tends to reliability.

AUTOMATIC VOLTAGE REGULATION.

Mr. Leonard Wilson, of the Denver office of the General Electric Company, gave a review of the methods employed for maintaining automatic voltage regulation on alternating-current circuits. He pointed out the importance of good regulation for incandescent lighting. For motors it is not so important, but induction motors take an increased current when there is a drop in voltage, and since this is usually at times when the feeder is carrying its maximum load it may be of importance.

The regulation may evidently be done either on the generators or on the individual feeders. The first attempts to make automatic voltage regulators for generators had motor-operated rheostats in the field circuit. These were too sluggish because of the time required by the motor to change the resistance. The Tirrill regulator overcame this by intermittently short-circuiting the field rheostat of the exciter. Regulation of alternators by compensating and compounding is not much used at present. He referred to the A. I. E. E. paper of Alexanderson on this subject. For regulation of individual feeders there is the induction type of regulator with a mechanically-shifted magnetic field and there is the transformer with multiple taps and a switch for connecting to various taps. By the use of a voltage relay and motor these types can be made automatic. A synchronous motor with properly adjusted field strength on the end of a long line is also a good automatic voltage regulator.

In the discussion of this paper Mr. E. P. Dillon called attention to the fact that it was in some cases cheaper to invest in a synchronous motor for power factor correction on the end of a line than to buy additional line copper to obviate the voltage drop due to a poor power factor.

TANK ARRESTERS ON CARS.

Mr. A. M. Ballou, electrical engineer of the Denver City Tramway Company, described in a brief paper the remarkable reduction in motor burn-outs due to lightning brought about by the placing on each car of a small water tank arrester. These tanks were 18 in. high, 13 in. long and 6 in. wide. With a carbon plate 11/32 in. by 1⅜ in. by 8 in. long, 1.5 amp. would flow through the water at 500 volts. The carbon is inserted during thunderstorms. The cost of equipping 225 cars was $2,081. The results were summarized as follows:

Season 1904, tanks not on, lightning damage.....	$4,876
Season 1905, tanks in use, lightning damage.....	2,022
Season 1906, tanks in use, lightning damage.....	380

This was in spite of the fact that the motors were older and more susceptible to lightning in 1906 than in 1904.

The "Question Box" occupied a prominent place in the proceedings of the convention, and the greatest of interest was manifested in its consideration. Following are the replies to the various queries brought before the meeting:

BOILERS AND ENGINES.

Which is best adapted for street railway work where the

distribution lines are short, a compound engine or a simple engine, both to be non-condensing?

Mr. A. M. Ballou said in the Denver City Tramway Company's power houses simple non-condensing engines showed a consumption of 7 lbs. of coal per kw hour and compound condensing engines took 4 lbs. He gave no figures on compound non-condensing engines. Simple engines regulate speed better. Mr. C. C. Chapelle cited the experience of two small Indiana interurban roads where the load fluctuated violently from zero to maximum, and where all cars were simultaneously standing at the ends of the line part of the time. One had cross-compound condensing engines, and the other simple non-condensing engines. The fuel economy was in favor of the simple engine.

Is it best to use steam or motor-driven exciters for railway alternators? What is the best feed pump drive for railway work, power, steam or electric?

Mr. Chappelle said if the main engines were condensing it was best to use steam-driven auxiliaries, as their exhaust could be used for feed water heating, and 96 to 97 per cent. of the heat recovered. Otherwise there was no economical means of heating feed water in such a plant. He mentioned that no less an engineer than H. G. Stott, of the Interborough Rapid Transit Company, New York, had experienced a change of ideas in favor of steam-driven auxiliaries the past few years. Mr. M. T. Morrill, of Golden, cited a small lighting plant with high-speed simple engines where the boiler capacity was hardly sufficient at the peak load. By putting in an electric feed pump the steam consumption was reduced so that a higher peak load could be carried. Mr. J. F. Dostal, of the Denver Gas & Electric Company, said his company had abandoned electric feed pumps for the reason given by Mr. Chappelle and also because of trouble with coal dust in boiler-rooms.

What type and kind of circuit breaker is the best for direct-current railway work, 500 to 600 volts, heavy amperage?

Mr. Ballou said Denver Tramway experience was that the carbon break circuit breaker required much less care and contacts were in much better condition after repeated opening. The company has many of each kind.

Would a feed water economizer placed in smoke conduit between boilers and chimney (stack temperatures ranging from 400 to 650° F.) be a paying proposition?

Mr. Chappelle thought it had been fairly well established that under usual conditions economizers were good investments wherever coal cost $2.25 per ton or over. In Colorado the large draft necessary to burn lignite coal might lower the limit somewhat. Mr. Ballou said the economizers in the Denver Tramway power house were earning 8 per cent. on the investment after allowances were made for maintenance and depreciation.

Is flake graphite spread on the tubes and drum inside of a water tube boiler effective as a preventive of scale?

Mr. C. K. Durbin said that at Albuquerque, N. M., he had found it very effective.

METERS.

Is it best to check and test meters at the station or on the line?

Mr. Clark, of Colorado Springs, said they tested meters on the line, as it was thought better to learn their performance in actual working conditions, and the meter tester could detect theft of current. Mr. Dostal said in Denver induction type meters were brought in and overhauled every two years, which was thought often enough. Commutator type meters must come in much oftener. Mr. T. F. Grover, of Trinidad, said his practice was to inspect and test every six months with a bank of lamps of known wattage. The tester also looks over the wiring. Mr. Tripp thought an inspection should be made once a year at least.

On a 500-volt, direct-current motor circuit with our lines, motors and meters well protected with lightning arresters and reaction coils we lose quite a number of meters in the late spring from lightning discharges. What remedy, if any, can you suggest for this?

Mr. Clark said the solution was to put the switch on the service side of the meter. The customer would frequently open his switch during a severe storm to protect his motors and this would protect the meter.

In metering a three-phase motor circuit, is it best to use one polyphase meter, or two single-phase meters?

Mr. Dostal said that the cost was about the same for one polyphase as for two single-phase meters, but the bookkeeping was so much simpler with one meter that they had adopted the polyphase meter at Denver. Mr. Clark, of Colorado Springs, pointed out that the burning out of the shunt coil in one polyphase meter made registration impossible, while with two meters the result could be approximated from the reading of one meter. Mr. Tripp said that this matter has come up in connection with some large consumers at Colorado Springs where considerable money was involved.

TRANSFORMERS AND LINES.

How often should oil be changed in oil transformers and switches for high-potential circuits?

Mr. Dillon, of Colorado Springs, said they cleaned out oil switches every six months. The oil was simply strained and put back in the switch. They started out last year to inspect the oil in transformers, but after looking over a lot the inspection was abandoned as unnecessary. Mr. Dostal said the experience just cited was similar to that at Denver. Oil switches had been in service three years with no attention.

Do grounded secondaries on transformers of a distributing system tend to increase the burn-outs of transformers from lightning?

Mr. Morrill, of Golden, said they had grounded neutrals, but had lost no transformers.

What is the most effective method of protecting high-voltage systems from lightning?

Mr. P. R. Sloat, of Central City, noted in this connection that on one of the Colorado transmission lines the iron wire used as a lightning protection had been taken down because it was more of a source of grounds than a protection.

LAMPS AND WIRING.

What progress have you made in installing high-efficiency incandescent lamps, Nernst lamps, or vapor lamps, in competition with gas or gasoline installations?

Mr. Goodale, of Colorado Springs, had found high-efficiency units very effective against gasoline. Six gasoline plants had been put out of business in the past four months.

On what basis are members giving free lamp renewals in towns of 10,000 or less?

The practice of free lamp renewals appears to be more common in Colorado than further east. Companies at Leadville, Golden, Greely, Georgetown, Idaho Springs, Pueblo and Trinidid give free renewals. Mr. Mayher complained that customers asked for too frequent renewals, but Mr. Morrill said he had difficulty in getting customers to bring in lamps frequently enough to keep blackened lamps off the lines.

Is it considered advisable in towns large enough to support a wiring contractor for the electric light company to discontinue the wiring business?

Mr. Mayher, of Greely, said his company got rid of the contracting business the first of the year and was glad of it. In that way the company got rid of making a lot of small repairs free on jobs that they had wired. These small troubles formerly took about the time of one man. F. C. Webber, of Leadville, said they had discontinued wiring. About two years ago an offer was made, open for one month, to wire any house and rebate the cost of the wiring on the lighting bills. About 150 houses were wired on this plan. Mr. C. M. Wright, of Pueblo, told of an offer made to wire residences free in Pueblo. In three months and ten days 532 houses had taken this offer. The cost of wiring had been $1.63 per outlet.

NEW BUSINESS.

Is it desirable in towns up to 15,000 population to have a contract agent to get new business?

Mr. C. K. Durbin said at Albuquerque, N. M. (population 12,000), he had two solicitors for a time and in a period of fourteen months spent about $3,000 on a new business campaign. The solicitors were good men, getting as high as $100 per month. The results did not justify the expenditure, and he quit the campaign. He still advertised in the newspapers and on illuminated billboards. Messrs. Goodale and Tripp expressed much surprise at this failure to get results which was contrary to the experience of numerous other companies.

What special inducement should be offered to get electric sign business?

Mr. Goodale said at Colorado Springs they sold signs on the instalment plan. The sign was paid for in two years along with the current bills. Most of the signs were made in Colorado Springs, as it was desired to give the business to local people. The presence of the signs themselves on the street was the best advertisement for the sign business.

What revenue can be counted on from an electric laundry iron in the home?

Mr. Goodale, of Colorado Springs, reported a revenue from 75 cents to $1 per month per iron. Mr. Morrill, of Golden, furnished the iron to customers for a deposit of $6 and credited to the customer's lighting account 50 cents per month for twelve months. The iron remains the company's property. The deposit is to insure the iron being used. The revenue was 50 cents to $1 per month. Mr. Tripp said a company could afford to furnish irons at half cost and charge half to advertising in order to get the irons on the lines rapidly so that they would be earning revenue. Delay would cost the company in lost revenue more than half the cost of the iron.

Adjuncts to the Power Load.

In a paper with the above title, presented at the recent convention of the Association of Edison Illuminating Companies, Mr. C. J. Russell, of Philadelphia, gave a thorough discussion of the possibilities of electric heating and of electrochemical processes for increasing the central load, and leveling the load curve.

The Philadelphia central station system serves printing establishments to which the value of electric heating appliances for linotype or monotype machines and all the operations of the stereotype rooms cannot be overestimated. Some of these establishments do binding, and to them the applications of electric heat to press heads, shaping machines, gluing processes, etc., would prove great money savers. It also serves laundries, to which electrically-heated machines would bring the same advantages as the domestic iron has to the residence.

The metal industries may find in the electric welding machine and in the electric furnace just what they need in the way of improved equipment. Textile mills have numerous process requirements which only need the application of electric heat to produce improved results.

The minor appliances are well known, such as soldering irons, glue cookers, special irons for the hat factory, warming pans and stoves for miscellaneous and special uses. The special applications for the binding and stereotype trades may not be so well known, but they have been well tried out, have proven very satisfactory, and data regarding their operation are readily available to those interested. The recent types of laundry applications are also giving very good satisfaction.

The data obtainable upon the operation of the various classes of machinery mentioned would seem to prove that the cost of heating becomes insignificant in the face of the greatly increased and improved output made possible by the use of electricity. In this, as in the power field, the decreased cost per unit perfect article produced controls the situation and may render the new method preferable at double the cost for energy alone.

The field for electric welding and tempering is unquestionably a large one, but machines for this purpose have not been as generally introduced as the publicity given to this class of apparatus and the remarkable results accomplished by its use would lead one to anticipate. It is also to be regretted that the method of installation generally urged and adopted has been in connection with a special generating equipment.

In the sizes up to 30 kw there can certainly be no valid reason presented for the installation of a special generator. There are several outfits on the system ranging from 15 to 30 kw capacity, and their effect is not greater than that of a motor of similar capacity. The load factor of these outfits is low, averaging three hours. The reason for this is understood when we consider that the longest period of welding in average work will not exceed 40 seconds, whereas the operation of adjusting and removing the work may occupy three to four times this length of time.

Proper presentation of the advantages of these outfits to accomplish specific results in large manufacturing establishments making metal articles of special shape should result in their more general use. There would also appear to be room in each large city for a jobbing shop to handle the work for smaller concerns which could hardly afford to make individual installations on account of the royalties charged upon the machines of a fixed sum per annum.

Suggestion of the use of a welding machine was made some time ago to a large power consumer under the following circumstances: In passing strips of expensive rolled metal between dies it was necessary to rivet succeeding strips together in order to allow continuous operation. When this riveted portion came along it was necessary to open the dies, resulting in quite a loss of the rolled metal. The welder was introduced and now makes a butt weld on these strips, the fin or burr being removed by an emery wheel on a flexible shaft. The dies can operate continuously, and the saving is from 5 to 8 per cent of the total length of metal worked.

In another case where thin discs of rolled, spun or hammered metal developed a defect at one portion of the rim, the almost completed article had to be thrown into the scrap pile. A welding machine is now used to weld a piece of metal on at the place of the defect, which is sheared off, and after completion it is impossible to detect the place where the joint was made.

In another case where repairs to costly pieces of large size constantly required careful soldering and refinishing, a welder was installed with such results as to reduce the time consumed in these repairs to one-sixth that formerly necessary. In this case certain articles were also manufactured requiring stamping from large sheets with much waste on account of their shape. The suggestion of welding these up from narrow strips was made and a few samples prepared. Within thirty days after these went out to the trade the welding machine had a steady six months' job on the books and our revenue increased from this source of current sales.

While most of the welding done is of the butt type, some special machines have been developed, one for making wire fencing and another for making longitudinal welds on pieces of large diameter, such as the joints in the shell of hot water boilers for domestic use.

The electric tempering process by use of the electric welding machine does not appear to have been developed to such an extent as its advantages would seem to merit. The heating of special shaped pieces by the ordinary means is often accompanied by distortion which is fatal to the article itself. When heated by the passage of an electric current this is not the case, and the tempering of such delicate articles as the rolls used for drawing cotton is successfully done by means of this process. The uniformity of the heat generated in this way in metal of small cross-section and the excellent tempering results obtained have proven eminently satisfactory in such special lines as have come under our observation.

The importance attained by the electric furnace entitles it to serious consideration from the central station standpoint. Foreign developments are attracting universal interest on this continent, and the next few years will probably witness extensive applications of the electric furnace in various industries on this side of the water.

The maximum temperatures attained in commercial furnaces range from 2,000° C. to 3,500° C., or from 3,632° F. to 6,332° F. The latter figure may be anticipated, since the latest determinations of the temperature of the arc approach 3,700° C., as given by the United States Bureau of Standards working with the Wanner, Holborn-Kurlbaum and le Chatelier pyrometers.

The tardy developments in this country have been due in a measure to the fact that the electrical furnace man and the central station man did not get together. The industries require comparatively large quantities of electrical energy, and almost up to the present time it has been assumed that water power alone could develop the current at a cost low enough to meet the requirements. Water power within available transmission distances of large centers has been in demand for light and power plants, and power sites not so situated may lack the facilities of transportation and of ample supply of raw materials essential to the operation of electric furnace processes.

In foreign countries the decadence of the calcium carbide industry caused an active demand for processes to utilize installations completed and under way, with the result that with modified furnaces a large and constantly increasing output of various ferro-alloys has almost completely annihilated the old cupola processes and products. The use of these alloys in the iron and steel industry has called for rapid extensions of existing electric furnace plants, and it is at this time estimated that fully 100,000 hp is being utilized for this purpose alone. From the production of ferro-alloys it would seem but a step to the production of steel. The step was taken and electric steel has been on the market in moderate supply for about five years.

Within the past six months considerable electric furnace work has been done in Philadelphia with current supplied from the central station system. One installation is of especial interest as being the first to produce high-grade crucible steel upon a commercial scale on this side of the water, by heat from electrical energy.

The furnace is of the induction type, of 131 kilovolt-ampere capacity, and is supplied with single-phase, 60-cycle current at 240 volts. It is in principle a transformer, the secondary of which is constituted by a circular trough-shaped crucible and its contents. The primary consists of twenty-eight turns of copper tube, cooled by internal water circulation and insulated by sectional layers of heat insulating materials. The transformer frame is mounted upon trunnions and fitted with gears and a hand wheel for convenience in tilting. The top member, which is removable, is provided with cams at each end for the application of pressure to insure good magnetic contact. Bolted to each side of the lower part of the frame are brackets, upon which rests a circular piece of soapstone which serves as a foundation for the crucible. The top lid, or covering, of the crucible is made in sections for convenience in introducing materials and for observing the process.

The manipulation of the furnace is very simple. In starting operations a cast ring may be placed in the crucible or a pot of melted metal poured in from another furnace and the current turned on. When this metal is at the proper temperature, materials are added in the right proportion and the whole brought to the condition desired and an ingot is poured off. When a pour is made sufficient metal is left in the crucible to maintain the circuit and new materials are at once introduced. Charging is done gradually in order to prevent freezing the mass. The fusion of the new charge ordinarily takes about thirty-six minutes and the total time between pours is from an hour to seventy minutes, according to the character of steel to be made. The secondary current is, at a maximum, 15,148 amp. at 8.57 volts. The current consumption varies with the percentage of carbon in the charge and finished steel, but it will average about 28 kw-hours to melt and a total of 36 kw-hours to a pour per hundred pounds of steel.

The temperature of the cooling water is only raised from 10 to 20° from inlet to outlet, with a very moderate flow. The heat insulation of the crucible is so perfect that the outside of the casing is barely warm to the touch while the furnace is in full operation. Starting cold, the power factor of the apparatus is rather low, but as soon as the metal in the crucible is heated to such a degree as to lose its magnetic qualities, it improves rapidly. When in full operation the power factor ranges from 93 to 97 per cent.

Careful observations of about sixty heats were taken with standardized instruments and much valuable data have been obtained. Several thousand pounds of each kind of high-grade steel of different composition used for cutting tools have been made in this furnace and samples submitted to chemical and mechanical tests.

Since the heat is generated in the crucible without external contact or influence, it is obvious that the resultant product will be free from contamination other than that due to the materials themselves and to the lining of the crucible. For this reason the character of the steel can be absolutely predetermined. The high temperatures attainable in the furnace render it possible to thoroughly remove all gases, and the steel is very fluid and still in the mold.

The ingots are very dense and homogeneous, and tools made from them present a grain and silvery lustre unlike that of the ordinary crucible steel. The metal also has valuable characteristic qualities for the manufacture of high-grade tools requiring uniform temper. The results obtained have been so satisfactory that it is proposed to install a five-ton furnace calling for about 750 kw current capacity.

The magnetic effect produces some difficulty in charging, but this is not serious when understood and properly avoided. It is evident that furnaces of this type can be readily designed for use on two or three-phase circuits. While no large furnaces of polyphase type have been manufactured in this country, two different forms have been brought out in France, one of which is much on the order of the one just described.

There is also in the Philadelphia system a furnace of 100 kw capacity used for the smelting of special ore. This is of the combined direct and indirect type, arcs being used to start the process and the current being subsequently passed through the materials which are conducting when heated. The work with this furnace has not reached such a point as to admit of more than a general reference to it. If as successful as the results abroad indicate, it is hoped that the preliminary work will result in a large installation with central station supply.

There are also two smaller furnace equipments, both used for tests in the smelting of various ores and for experimental purposes.

The electric furnace presents marked advantages over the old crucible methods. The first cost is from 20 to 25 per cent of that of gas furnaces of similar capacity. There is no great mass of surrounding and containing materials to be heated to a temperature even higher than that necessary for the operations of fusion and refining. Repairs of all kinds are cut down to a small figure. The expense of crucibles in the gas processes amounts to from $10 to $16 per ton of steel, as against $2 to $4 per ton with a built-up induction furnace. The cost of labor is radically reduced and the discomforts of the old process are almost entirely done away with.

Among electrochemical processes, that for bleaching is promising. By passing a current of electricity through a solution of common salt, hypochlorite of sodium, or electrochlorine, is obtained. In properly arranged apparatus no gas escapes, which is a point of vast importance to the manufacturer. The activity of nascent products is well known and it can be readily understood that the work done in this manner is superior and much more permanent than that done by the older methods.

This process has been widely adopted abroad, where 2,000 hp is used for this purpose in various establishments in a type of cell put out by the Siemens-Halske Company. It has also been adopted by several leading manufacturers in this country and is highly recommended in the linen and cotton trades. The process is also applicable to the bleaching of fibres for paper, artificial silk, oils, etc. Some work of this character has been done on the Philadelphia system and a motor-generator outfit of 15 kw capacity has been found ample for the satisfactory bleaching of a ton of fibre per day of ten hours.

The expansion of electric processes for bleaching, finishing and water-proofing fabrics will be an interesting subject to follow up for central stations desiring to sell energy for electrolytic work.

Another promising outlet for the sale of energy is the industrial application of ozone. Regarded as a rare product until recently, and its production as a laboratory experiment, several large establishments are now producing this powerful agent in large quantities for bleaching and purifying purposes. Some of the most practical of its uses are in the bleaching of flour and

starches, of textile yarns and fabrics, of paper pulp intended for the higher grades of product, the refining of alcohol and spirituous liquors, the treatment of varnishes and oils and for the purification of water used for drinking or manufacturing.

The last named application is the widest one and here ozone has proven its superiority over all known methods. The purification and sterilization of water without destroying any of its natural qualities, without the addition of any chemical compound and at a minimum cost, is a subject that vitally interests all classes of industries and individuals.

A gramme of ozone may be obtained with the expenditure of about 60 watt-hours. Two hundred and fifty gallons of water of average river variety can be treated with this amount of ozone. Naturally the amount of ozone required depends upon the number of colonies, or thousands, of bacteria present in the water. With an average of 200 per ounce, none remain after the amount of treatment described. With 2,000 to 4,000 per ounce, from 3 to 30 remain if the process stop at this amount of ozonization.

The method of treatment consists in aerating the water with ozonized air in apparatus arranged to make the air thoroughly mix or come in contact with every part of the water.

The electrical apparatus for the treatment of the air consists of a step-up transformer delivering high potential current, about 60,000 volts, to specially arranged discharge plates between which the air passes on its way from the pump which forces it through the water. The air may be dried by refrigeration or by chloride of calcium before it passes to the discharge chamber.

Two types of ozone generators have been used on the Philadelphia central station system. In one the dielectric was of glass and the discharge plates in multiple, each provided with a high series resistance which permitted of the cutting out of any which developed defects. In the other the discharge took place across air-gaps, and a choke coil and condenser were provided to prevent the formation of an arc and to raise the secondary voltage.

One of the installations mentioned was put in for the purpose of improving spirituous liquors. The method of treatment is similar to the water purification process, and the object is to produce within a brief period all the qualities given by age to liquor of different sorts. With the expenditure of a few kilowatt-hours per barrel very crude raw liquor can be made equal to that which has been aged in wood for several years.

The character of load diagrams of all central stations which have cultivated the electric motor field has undergone a radical change. In such cases the old condition of morning and evening peaks which represented almost the total generated load has passed. In the present load diagrams the kilowatt area of such peaks as exist bear a much smaller ratio to the area of the daylight load.

As a matter of fact, electrothermic processes require for their successful and economical operation nearly continuous supply. The initial operation of bringing the furnace and materials up to the proper working temperatures may involve three times the energy required for their operation thereafter. Not only is this true, but the chilling and reheating of such furnaces is an operation quite as destructive to them as to the older apparatus.

Electrolytic processes are mostly continuous. They depend for their successful operation upon a certain ampere density at a fixed voltage, and from this it is obvious that the only method of control would be to cut out cells or sets of cells when the current supply must be reduced. Many of these operations are chemically reversible, and the effect of shutting down the process would involve considerable attendance.

Barring out as impracticable the filling in of all the depressions, either process could be supplied with a capacity of 240 kw for 20 hours per day in winter and for 24 hours in summer, without exceeding a winter maximum peak of 1,643 kw; and that a capacity of about 550 kw could be supplied for 7 hours per night at any period of the year. The addition of these processes to the system would place on the counter chart an area of 8,650 kw-hours, and on the summer chart an area of 9,610 kw-hours.

After discussing the question with relation to a specific set of load curves, the author concludes that while it may be possible to find processes to fit into the conditions shown in these diagrams, he has never seen anything of the nature of an efficient intermittent process, and that electrothermic and electrolytic propositions must be considered on a straight 24-hour basis and handled in all respects as any other business of similar load factors. It may also be concluded that for purposes of load equalization it would only be possible to add such processes to any system as should be under the absolute control of the central station interests which were to supply them with electric current.

One of the most important points in connection with such processes as involve the supply of large volumes of electrical energy is the question of location with regard to the station. The elimination of distribution expense to a large extent, as well as the fact that the service investment would be very low, should make quite a difference in the rates central stations would offer to such industries as located in their immediate vicinity.

While water power may seem reasonable, these items of expense may make central station service in some other and more favored locality the cheaper in the end.

There are some electrochemical industries located now in out-of-the-way places which could obtain better results near some of our great shipping centers, for the reason that the cost of transportation of raw and finished product plus the loss of certain by-products which cannot now be utilized, more than offsets the advantages gained by the price of energy at the present location.

A study of the various electrochemical industries will reveal that purchased electric power has been attractive to them for the reason that their inception was experimental and the exact type of equipment needed was unknown. The installation of large generating units under such circumstances was not warranted, whereas it was possible to purchase transforming apparatus adjustable to several possible conditions.

Here is where the advantage of central station service comes in. We can meet these exact conditions and, with the facilities it is possible to offer them and the low rates we can name them for 24-hour business, it would appear that the attraction of locating in accessible and desirable market centers should make it possible to present some very strong arguments for this class of business.

There is one point in considering these electrochemical and electrothermic propositions which should be represented in its true light in every possible case. In estimates of the current used for any given operation, either furnace or electrolytic, foreign usage, sanctioned by adoption on this side of the water, has adopted the unit electrical hp-year. In estimating, if a pound of finished product requires the expenditure of 746 watt-hours, for example, the cost of an electrical horse-power for one year is divided by 8,760 (24 hours $\times$ 365 days), and the result is assumed as the cost of energy per pound of finished product.

No process can continue at its maximum for 24 hours a day and 365 days per year. Furnaces need repairs, baths need renewing and overhauling—in fact, the very processes themselves require considerable current regulation and are not prosecuted at a maximum rate. These, as well as humane reasons, prevent the fulfillment of the figure named. If the actual use averages from 50 to 70 per cent of the maximum, and we have never seen the latter figures continually exceeded, quite a radical change in the estimated cost per pound of finished product as well as per kilowatt-hour utilized has been effected.

As a practical check upon this it is rather satisfactory to learn the electrical capacity of an installation, the amount of energy estimated per pound of product, and then to learn the actual amount of finished product turned out in a year. The results of this character of information received from several operations in different parts of the world would seem to indicate that, if the amount of calculated energy per pound is correct, the actual load factor of the plants runs from 30 to 50 per cent based upon a 24-hour day and a calendar year.

The kilowatt-hour is the only true basis for calculation, and the cost of this unit for purposes of estimation should be based upon the cost of a kilowatt-year, modified by the actual or calculated load factor. Computation along these lines, taking into account the cost of transportation of materials, will show the range of possible business in the field of large electric furnace and electrochemical operations.

As adjuncts to the power load, electrothermic appliances and electrochemical processes offer means of increasing the usefulness of the central station and broaden the field of salesmanship.

Central Station Work at Franklin, N. H.

The city of Franklin, N. H., has a population of about 6,000 inhabitants, which is served by one of the most progressive of the smaller central stations in the State. In common with many other central stations in Northern New England, the source of power in this plant is hydraulic, so that the rates for power and lighting are especially favorable in the community. Electricity for lamps is sold on meter rates at 12 cents per kw-hour, and that for motors is sold on a meter basis to small consumers at 6 cents. A flat rate is also in force for incandescents, the tariff being $6 per 16-cp lamp per year. Very large power consumers are given rates running down to about $35 per hp-year on 10 hours' run per day.

At the office of the company on Memorial Street, in Franklin, an attractive exhibit of electric heating appliances has been fitted up close by the cashier's window. The power station adjoins the office, and its equipment is all hydro-electric. A single line shaft traverses the station from end to end. In the basement are three Stillwell-Bierce turbines, which are belted to the countershaft and controlled by a Lombard governor, operating under about 15.5 ft. head of water. The generating equipment is all belted to the shaft for the sake of flexibility, and also because the original station layout was of this character. There are two General Electric alternators of the old monocyclic type, 100 and 120 kw, respectively, wound for 2,300 volts, 60 cycles, speeds, 900 and 600 r.p.m. respectively. These machines are separated in operation from the more modern equipment of the station, which consists of a 12-pole, 150-kw, three-phase General Electric revolving-field alternator, wound for 2,300 volts, 60 cycles, speed 600 r.p.m. The exciter for this unit is a 2-pole, 45-kw, 125-volt General Electric machine belt-driven at 1,800 r.p.m. from the generator shaft.

No direct-current power is sold by the company, but the power station is equipped with a special dynamo for charging the storage battery of the city fire alarm system. In case this breaks down the battery can be charged from the exciters. The battery consists of sixty cells of the Electric Storage Battery Company's type B T elements arranged in two sets of 30 each. The battery has a capacity of 6 ampere hours at the 8-hour rate. It is charged every 48 hours.

A new power plant is being built by the company about three miles away from the present installation. This plant will have a capacity of 180 kw, and will contain a three-phase, 2,300-volt Westinghouse unit of that size direct-driven from a 300-hp S. Morgan Smith water wheel, which will operate about 6 hours per day under 100-ft. head. The storage capacity of the plant will not permit of larger use as yet, but it is expected that the new equipment will prove of material assistance in handling the peak load.

One of the most interesting loads on the company's service consists of the new municipal pumping plant on the Giles estate. This plant pumps water from driven wells into a circular covered reservoir of concrete, which has a capacity of 248,600 gals. The reservoir and pumping station were built by the Savage Concrete Construction Company, of New York City. The pumping station is a concrete building 20 ft. by 22 ft. inside dimensions, with concrete floor and slated roof. The cost of the building was $1,559, including all inside and outside finish. The cost of the reservoir was $3,558.40. The building is of Portland cement concrete composed of one part by volume of Vulcanite cement, two parts of clean sand and four parts of screened gravel. The architect was E. H. Boyden, of Boston. The walls, above the ground level, are 14 in. thick, with a 2-in. air space to keep out moisture, heat and cold. At the floor level the walls are 2 ft. 6 in. thick. The roof is covered with the best Brownsville slate. The floor is of concrete, 6 in. thick, and the building is large enough to accommodate a second pump. The building is located about 250 ft. east of the Pemigewasset River.

The plant consists of one Goulds single-acting, outside packed triplex, plunger pump, having a water cylinder 8 in. in diameter with 10-in. stroke. It is mounted on a cast-iron bed plate, which also carries one 20-hp, single-phase, 60-cycle, 110-volt, slow speed Wagner alternating-current motor, direct-connected to the pump by means of a rawhide pinion on the latter. The power is supplied by the Franklin Electric Light and Power Company, a step-down transformer equipment being located at the station. The gearing between the pump and motor allows about 41 r.p.m. of the former. At each revolution the pump delivers 6.5 gals. of water; hence the capacity of the pump at the above speed is 266 gals. per minute, or 383,760 gals. per 24-hour day.

In order to intercept the sand, and especially the air, which is liable to intercept the suction mains, there is connected with the later a riveted plate tank 5 ft. 7 in. long by 3 ft. 4 in. in diameter, placed horizontally. To this chamber is connected a vacuum pump with water-jacketed cylinder 5 in. by 6 in. This small pump is operated by an independent 3-hp Wagner single-phase motor, which is started and stopped automatically by the action of a float in the sand and air chamber. The motor is thrown directly upon the line in starting. A hand hole in the bottom of the chamber enables any accumulation of sand to be removed. The machinery of the pumping plant is mounted on concrete foundations. The plant can be controlled not only at the new pumping station, but also at the Bow Street pumping station of the city, and at the lighting plant. Its cost complete on foundations was $2,380.34.

The officers of the Franklin Light and Power Company are: President, A. H. Sulloway; treasurer and superintendent, J. P. Proctor.

The Burning of Cheap Fuels.—II.

There are numerous systems for burning cheap fuels in boiler and other furnaces. Most of these use a blast of some sort and shaking grates, while there are others in which the blast is used with stationary grates. Of the former the McClave system is the most widely known and this system is used extensively in the anthracite regions. The form of grate used is No. 3, which is especially adapted to burn the smaller sizes of anthracite, such as buckwheat, rice, birdseye, barley, etc. The grate bars are made with sectional removable tops with shanks, which are mounted in a socketed body portion and held in place by soft steel lugs cast in the bottom of the shanks, which are bent under the bottom of the bar. The bars proper are two inches below the bottom of the fire, so that there is no danger of their being burnt out or warped from the fire above. In case one of the tops should be broken or burned it can be replaced with a new one instead of putting in an entirely new bar. The bars extend laterally across the furnace and are furnished with journals at each end which fit into boxes in the side bearing bars, thus permitting the grate bar to rock to and fro. The grate is divided into sections and the bars composing each section are joined together by a common connecting bar to which a shaking lever is connected by a rod. This arrangement makes it possible to

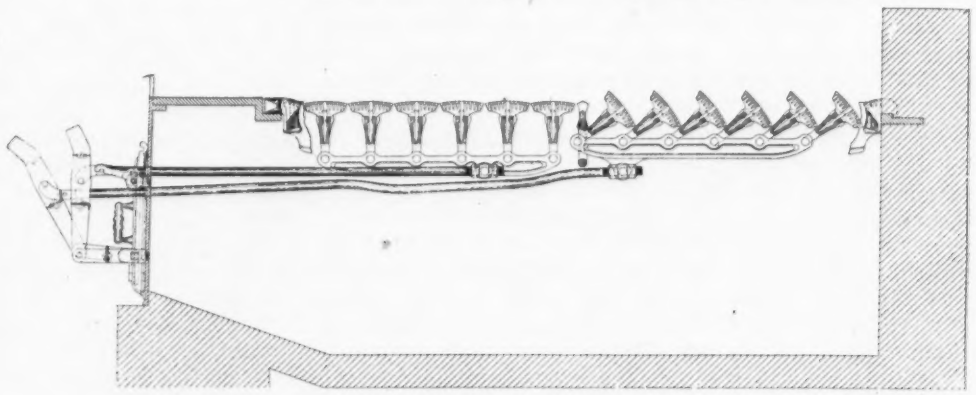


FIG. 1.—M'CLAVE SHAKING GRATE.

clean either section of the grate without disturbing the other. To give the fire a thorough cleaning, the operating lever is placed on the stub levers which are operated back and forth to the full extent of the movement both ways. This causes the formation of pockets on either side of the vertical line of the grate bars alternately, which prevent unnecessary loss of fuel when operating the grates as the bars mow down a fixed quantity at each stroke. When the fuel clinkers badly, the unconsumed fuel on the front series of bars may be shoved back on the rear series and the clinkers and ash on the front bars cut down by operating the bars in this series to the full extent of the movement both ways. The unconsumed fuel may then be drawn forward on the front series and the refuse on the rear series treated in the same way after which the unconsumed fuel may be redistributed.

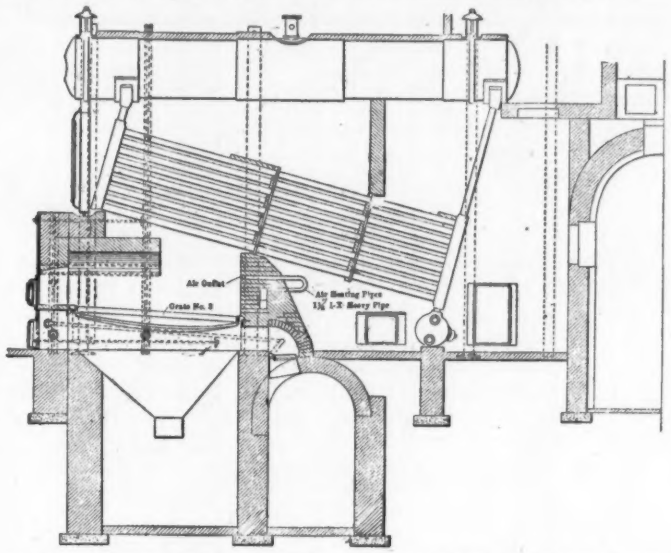


FIG. 2.—M'CLAVE SYSTEM APPLIED TO A BABCOCK & WILCOX BOILER.

Figs. 2, 3, 4, and 5 show the application of this system to four of the more common types of boilers in use. In all of these the furnace is provided with a brick arch over the grates, making of it a "Dutch" oven. Draft is furnished by a fan in Fig. 2, the damper being placed in the bridge wall as shown. Additional air is supplied through the bridge wall, the air finding outlets into the fire through the pipes in the wall, as indicated in the engraving. The setting shown for the other water-tube boilers is intended to burn bituminous coal under natural draft, the same setting being also used for burning the cheaper anthracites. With bituminous coal additional air is admitted through the bridge wall and also over the fire arch in the "Dutch" oven. In the return tubular boiler the Argand steam blower is used for draft and additional air is admitted through the bridge wall as indicated.

One of the most interesting applications of this system was seen by the writer at the People's Coal Company's Oxford mines in Scranton, Pa. It was fitted to Maxim water-tube boilers burning anthracite refuse from the colliery, which made a fire the like of which is seldom seen outside a blast furnace. The construction of this boiler is shown in the accompanying engraving. The furnace is constructed of fire brick and is built under the boiler so that there is no loss from radiation from the top of the highly-heated roof of an external furnace. Fire brick combustion chambers are provided so that the combustion begun in the furnace may be completed before reaching the heating surface. Between the furnace and each combustion chamber there is a throat contracted to the proper size for draft, thus insuring better combustion by an intimate mixture of gases. The boiler is especially adapted for burning cheap fuels and the ratio

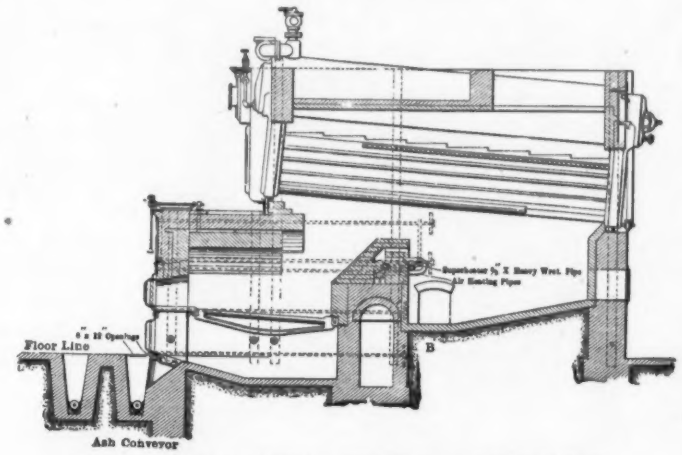


FIG. 3.—M'CLAVE SYSTEM APPLIED TO A HEINE BOILER.

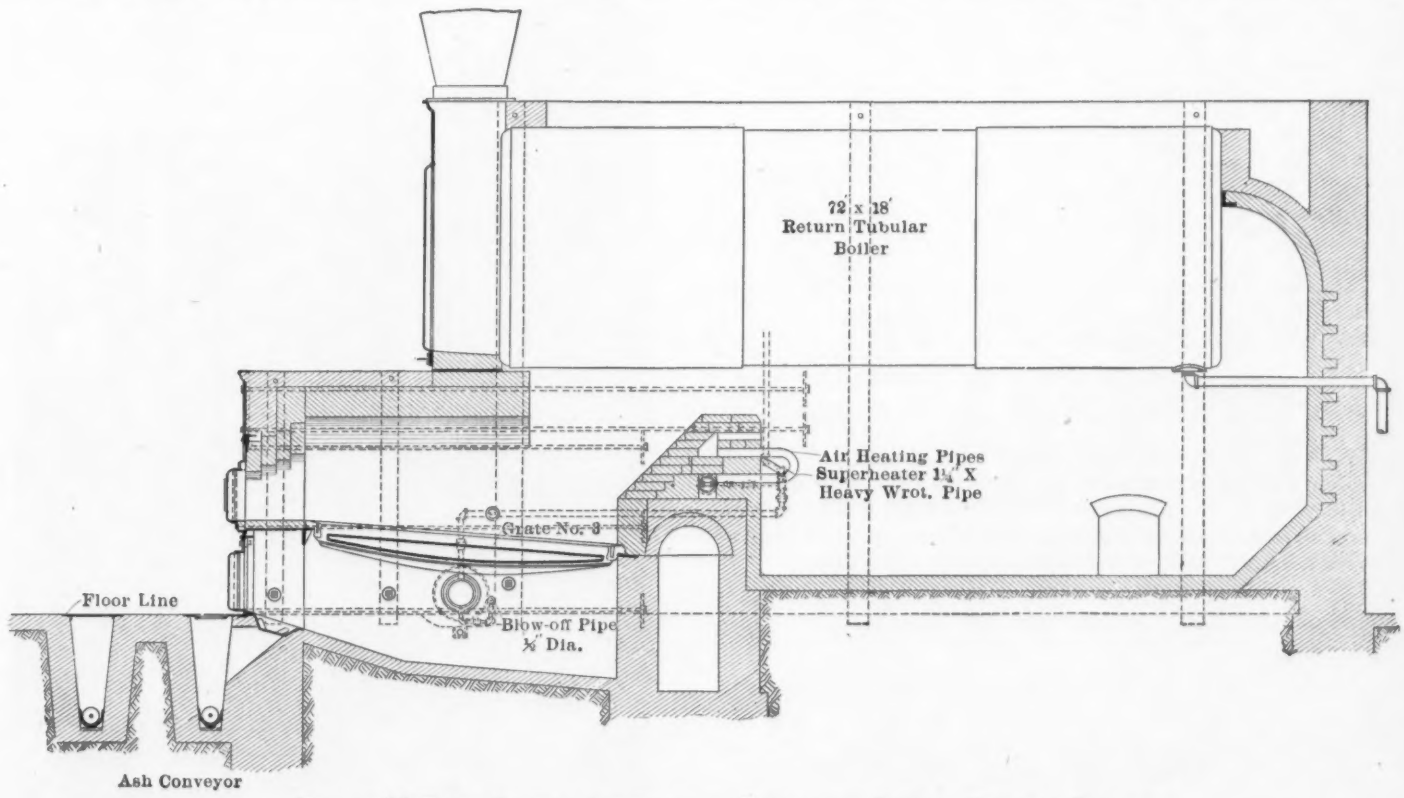


FIG. 4.—MCCLAVE SYSTEM APPLIED TO A HORIZONTAL RETURN TUBULAR BOILER.

of the heating surface to the grate surface is about 25 to 1. The heating surface is arranged so as to break up the currents of heated gases and extract the available heat from them. The gases travel three times the length of the tubes and the form and direction of the current of gases is changed seven times between furnace and chimney, thus producing a very low temperature of the escaping gases, which combined with the high temperature of the combustion chamber insures a very economical performance. The boiler as the appended tests show has a high

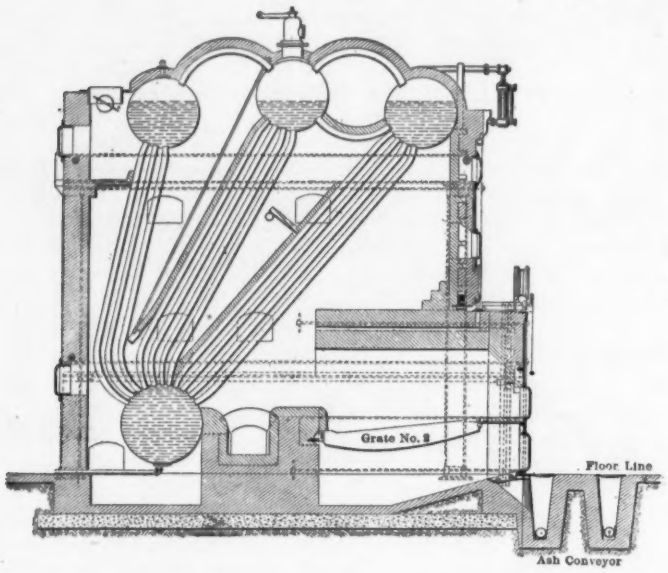


FIG. 5.—M'CLAVE SYSTEM APPLIED TO A STIRLING BOILER.

evaporative capacity per square foot of heating surface, thus making it possible to work it far beyond its rated capacity. The floor space occupied is only that required for the furnace. The tests, which were made by disinterested engineers for the purchasers, speak for themselves.

Test of Maxim boiler made at the People's Coal Company, Oxford Colliery, Scranon, Pa.:

Heating surface	3850 sq. ft.
Grate surface	152
Ratio heating to grate surface	25.4 to 1.
Rated horse-power	350
Heating surface per hp	11 sq. ft.
Proportion of air space in grate	25%
Number of 3-in. water tubes	322
Average length of tubes	14-ft. 8-in.
Diameter of steam drum (1)	4-ft. 0 in.
Diameter of mud drum	3-ft. 6-in.
No. of steam blowers (McClave Pat.)	8
Diameter of air inlet	12-in.

The fuel was anthracite coal, refuse of the colliery and contained 14 per cent of moisture and when dry 24 per cent ash and refuse. A dry sizing test gave parts as follows:

No. 3 buckwheat over ⅛ round plate and through 3/16 round	32.55%
No. 4 buckwheat over 3/32 round plate	44.20%
Dirt through 3/32 round plate	23.25%
	100.00%

Two tests were made, one called a capacity test, made by a rapid rate of driving, and the other called an economy trial, made to determine the economy when driven at a rate supposed to be near that of maximum economy and rated capacity.

The following table gives the principal results obtained in the economy trial, together with the capacity and economy figures:

	Economy test, 6 hours						Capacity test, 4 hours					
	Coal burned per hour.	Water evap. per hour.	Water evap. from and at 212 pr. lb. of coal.	Temp. in stack.	Moist in stack.	HP.	Coal brnd. per hour.	Water evap. per hour.	Water evap. from and at 212 per lb. of coal.	Temp. in stacks.	Moist. in team.	HP.
Av.	1650	17385	10.53	561	1.7	579	3096	26433	6.54	650	2.2%	887

The draught was supplied by eight No. 6 McClave steam jet blowers, discharging in the ash pit under the grates. The firing was done by the regular fireman. Fire was cleaned at the beginning of the test. The coal and ashes were weighed, the water measured in a large tank. Pressure and temperature were noted every fifteen minutes. The temperature of the stack gases was taken by a mercurial thermometer. The boiler had been running for six weeks continuously previous to the trial without

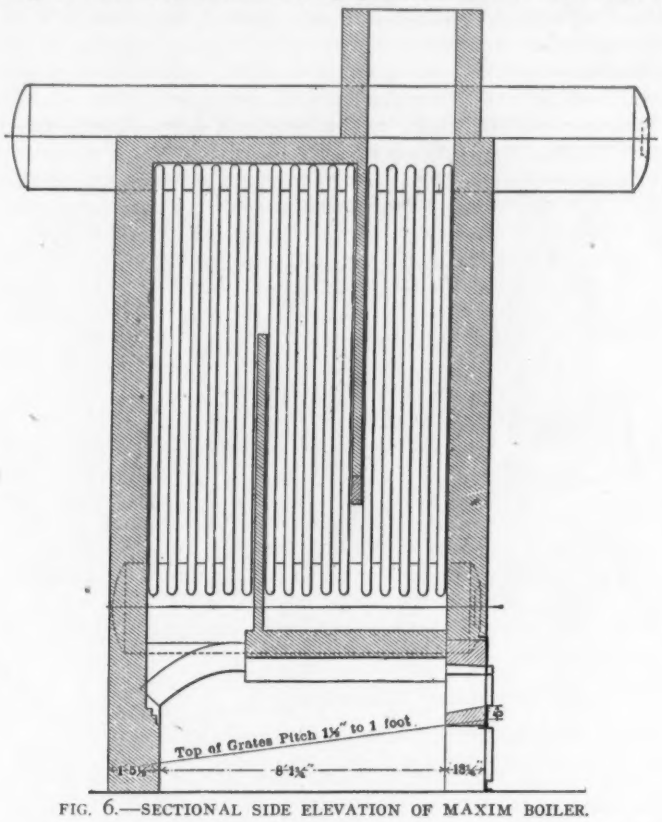


FIG. 6.—SECTIONAL SIDE ELEVATION OF MAXIM BOILER.

cleaning, water drawn from the gage class being extremely dirty. The boiler was situated in the open air and about one-

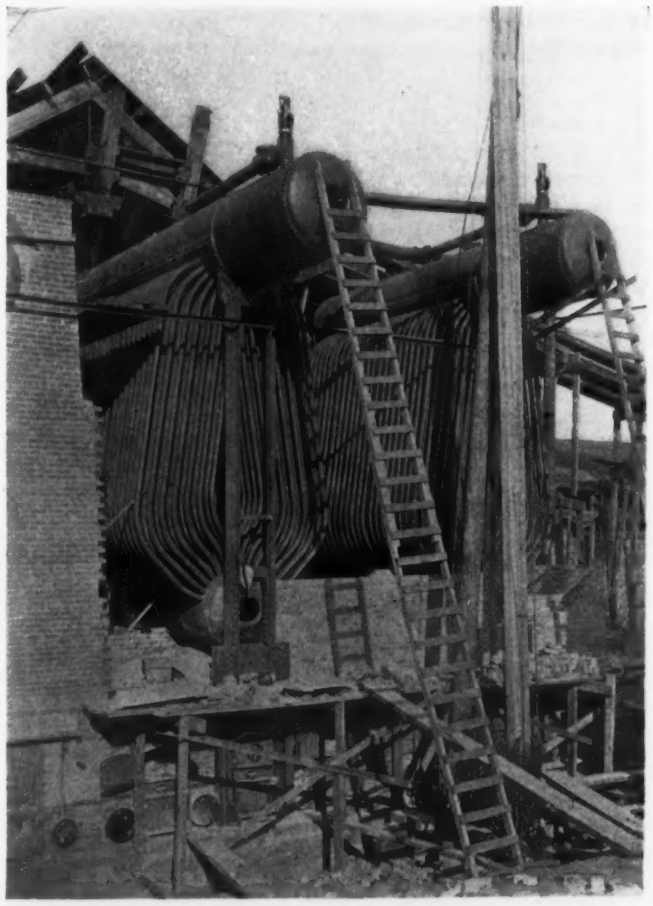


FIG. 7.—MAXIM BOILERS AT OXFORD COLLIERY, SCRANTON, PA.

third of the upper drum was uncovered and open to free external radiation.

Descriptions of other systems for burning cheap anthracites with recent tests will be published in subsequent issues.

The Burning of Washer Slate and Coke Braize.

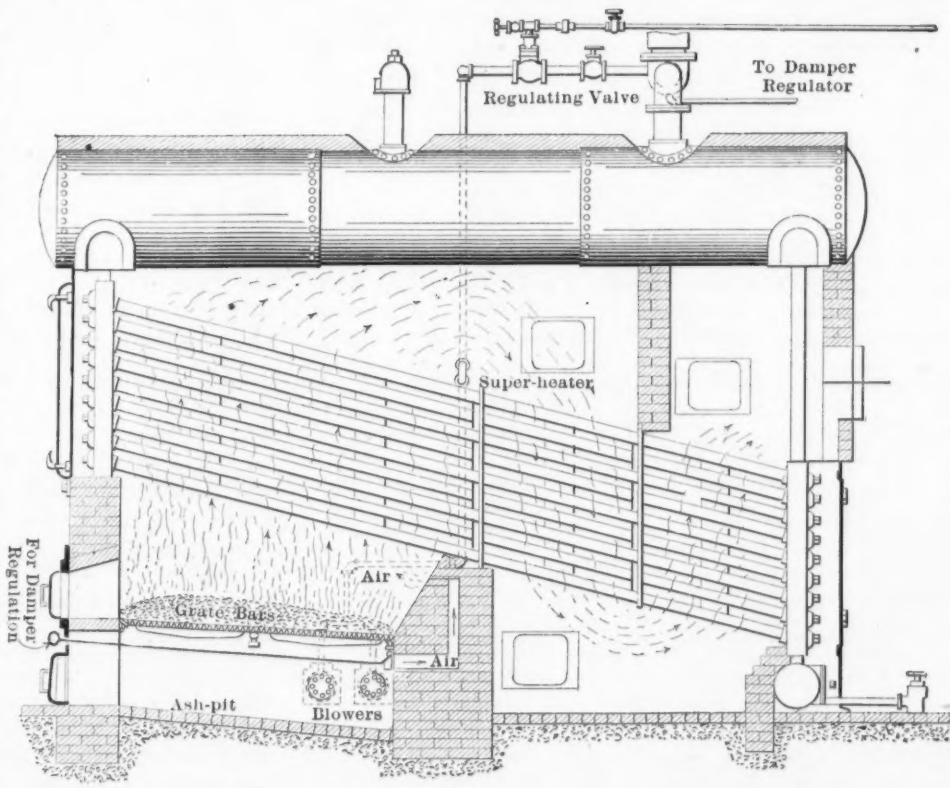
By C. G. Atwater.

WHILE operating a boiler plant at Sydney, Cape Breton, the writer had an experience in the burning of washer slate and coke braize that may be of interest to those concerned in the use of such low grade fuel. The plant in question was of 1,500 rated horse-power and consisted of six B. & W. type water-tube boilers, arranged in three batteries of two each, in a single row. A steel draft flue extended overhead along the back of the boiler settings leading to a 7x125-ft. brick stack at one end. The boilers were originally provided with an extension furnace or Dutch oven, containing ordinary grate bars, the surface being 8 ft. wide and 7 ft. deep. While this type of furnace may have advantages for some fuels, it was not adapted to the low grade fuel under trial.

The coal used was from the local mines, and while it was low in ash and high in calorific value, it carried from two to three per cent of sulphur, coked strongly on the grate bars, and slagged badly, making it difficult to fire economically on ordinary grates. This coal was used in the by-product coke ovens to which the boiler plant was tributary, and in washing it to reduce the sulphur a large amount of refuse slate had been piled up. It was proposed to ascertain whether this slate, either alone, or in combination with the refuse coke braize, constantly produced from handling the coke, could be used successfully for making steam. As the slate was at hand for merely the cost of loading, and the braize was loaded on cars in any event to get it out of the way, it was evident that the prospect of saving money was good, if the material would make steam.

In order to determine the facts in a direct and conclusive manner, alterations were made in the boiler furnaces, and a series of tests carried out, the object, in general, being to find out the best form of furnace and grate for burning the slate and braize, and, incidentally, what might be expected from the coal itself.

One boiler was fitted with the grates, bridge wall and steam jet blower on what is known as the Parsons system, retaining the "Dutch" oven, and one was fitted with the same apparatus, but with the "Dutch" oven removed, and the grates placed beneath the boiler tubes, as is the usual practice. The grates in question, it may be said, consist of flat cast sections fitting closely together, the only draft space being the small holes ¼ in. in diameter, with which they are pierced. Pressure is supplied to the ash pit by a steam jet blower, the ash pit doors being tightly sealed. The draft holes are so small that practically no ash drops through, the fire being cleaned through the upper door entirely. The arrangement of the boiler and grates without the "Dutch" oven is shown in the illustration. A third boiler was tested in the original condition, without alteration in any respect.



ARRANGEMENT OF BOILER AND GRATES WITHOUT THE "DUTCH" OVEN.

Nine tests were made in all, and although tests 2 and 9, 3 and 8, and 6 and 7 were with the same apparatus and fuel, the series was progressive in character, and it therefore seems worth while to reproduce them all.

Fuel was weighed in a wheelbarrow on platform scales. A handful from each barrow was taken, and the sample for analysis quartered down from total amount.

Water was fed into the boiler by an injector. The water was weighed by alternately filling and emptying two calibrated barrels, the injector taking water from a suction barrel placed below these two.

The temperature of the water entering the injector was taken by a thermometer suspended in one of feed barrels.

A thermometer placed in the pipe line gave the temperature of the water entering the boiler. Readings were taken every hour.

The amount of water entering the boiler as condensed steam from the injector was calculated from the following formula:

$$S = W\ (h^2 - h^1) \div (h^3 - h^1), \quad \text{where}$$

S = weight of steam.
W = weight of water entering injector.
h^1 = Heats units per lb. of water entering injector.
h^2 = Heats units per lb. of steam entering injector.
h^3 = Heats units per lb. of water leaving injector.

The temperature of the stack gases was taken by inserting a pyrometer through a hole drilled in the side of the up-take. Readings were taken every half hour.

The pressure of steam was read from the gauge on the boiler every half hour. All six boilers discharged into one header.

Sample of ash was taken by method of quartering and the tubes were blown previous to each test. No calorimeter tests of the quality of the steam were made and no determination was made of the steam used in the blower.

The writer regrets that the first mentioned test was not made in every case. The fact that three different boilers were used, necessitating individual calorimeter connections; the difficulty of obtaining suitable supplies in that country, and that the tests were regarded as sufficient for the purpose if they furnished a fair comparison of the different conditions, must serve as his excuse. As regards the steam used by the blower, the actual determination of this point was a matter beyond ordinary testing methods. Repeated standardizations of the jets, as used under operating conditions, are stated by the manufacturers to show that the steam consumption is well within 5 per cent of the steam made.

Test No. 1.

The object of the test was to obtain the maximum horsepower, and at the same time to keep the temperature of the flue gases low. The fuel used was run-of-mine bituminous coal. Just before the start the old fire was drawn, all clinkers removed, and a new fire started. The condition and amount of fire on the grate was noted, the height of water in gauge glass measured, and the test commenced. As soon as the test was stopped, the fire was drawn, all clinkers removed, and a new fire built on weighed fuel, and brought back to the same condition as at

the start. The cleaning period was, therefore, not included in the test. The clinker was easily removed from the grate. The time required for cleaning, thirty minutes.

	Moisture.	Combustible.	Ash.
Coal	3.45%	91.74%	4.81%
Ash	—	16.22%	83.78%
Total ash obtained, less 10% for moisture			585 lbs.
Total combustible in ash, calculated from chemical analysis.			95 "
Per cent of total combustible lost in ash			1.03%

Test No. 2.

The object of this test was to get a comparison between the "Dutch" oven with the Parsons grate, and the "Dutch" oven with natural draught under forced conditions. The fuel, start, and ending were the same as in test No. 1. Too rapid firing at start, together with lack of draught, caused by keeping temperature of flue gases low, resulted in the formation of a thick bed on the grate, which remained unburned. The ash in the test was therefore estimated. The clinker adhered very strongly to grate bars. The time required for cleaning was one hour.

	Moisture.	Combustible.	Ash.
Coal	1.22%	94.64%	4.14%
Ash	—	39.52%	60.48%
Total ash less 10% for moisture			450 lbs.
Total combustible in ash			177 "
Per cent of total combustible of fuel lost in ash			2.37%

Test No. 3.

The object of this test was the same as in tests No. 1 and No. 2. The fuel, start and ending were the same as in test No. 1. The fire was easily cleaned, and the clinker did not adhere to the grate. The time taken for cleaning was thirty minutes.

	Moisture.	Combustible.	Ash.
Coal	2.85%	93.91%	3.24%
Ash	—	24.56%	75.44%
Total ash less 10% for moisture			729 lbs.
Total combustible in ash			179 "
Per cent of total combustible lost in ash			1.61%

Test No. 4.

The object of this test was to obtain a maximum value for the pounds of water evaporated per pound of fuel. The fuel used was slate residue from coal washing plant. The start and ending were the same as in test No. 1. The low weight of ash actually obtained was due to the large amount of fine material carried over by the forced blast, and to the difficulty of obtaining a fair sample of slate for analysis. The fire was cleaned at the end of the fourth hour, and after the test had stopped. The clinker was easily removed. The time consumed in cleaning was forty minutes.

	Moisture.	Combustible.	Ash.
Fuel	7.91%	62.25%	29.84%
Ash	—	25.16%	74.84%
Total ash less 10% moisture			2,935 lbs.
Total combustible in ash			738 "
Per cent of total combustible lost in ash			7.23%

Test No. 5.

The object of this test was the same as in test No. 4. The fuel burned was coke braize. The start and ending were the same as in test No. 1. The low weight of ash actually obtained was due to the same reasons as given in test No. 4. On account of the low percentage of volatile matter in the braize the damper could be closed more than in test No. 4. This accounts for the lower temperatures of the flue gases. The fire was cleaned as in test No. 4, and the time for cleaning was forty minutes.

	Moisture.	Combustible.	Ash.
Fuel	4.75%	75.65%	19.60%
Ash	—	39.40%	60.60%
Total ash less 10% moisture			2,328 lbs.
Total combustible in ash			917 "
Per cent of total combustible lost in ash			6.96%

Test No. 6.

The object of this test was to discover if braize and slate mixed in equal amounts gave better results than either used alone. The start and ending were the same as in test No. 1. During the test the fire was frequently leveled. The fire was cleaned as in tests No. 4 and 5, and the clinker was easily removed. The time taken for cleaning was forty minutes. The reason for the low weight of ash actually obtained was explained under test No. 4.

	Moisture.	Combustible.	Ash.
Fuel	5.60%	67.40%	27.00%
Ash	—	42.40%	57.60%
Total ash less 10% moisture			2,706 lbs.
Total combustible in ash			1,147 "
Per cent of total combustible lost in ash			11.82%

Test No. 7.

The object of this test was to repeat test No. 6 and not use the leveling rod, in order to discover if the fire could be run longer without cleaning, and if better results could be obtained. The start and ending were the same as in previous tests. The fire was cleaned at the end of the third hour, and after the close of the test. The clinker was easily removed, and the time for cleaning was thirty minutes. A low weight of ash was obtained for reasons explained under test No. 4. By filling in the open spots in the fire with fresh fuel, instead of using the leveling rod, it was found that the fire was much improved. Clinker did not form so soon, a higher horse-power, and a higher value for pounds of water evaporated per pound of coal, were obtained.

	Moisture.	Combustible.	Ash.
Fuel	3.27%	65.33%	31.40%
Ash	—	23.32%	76.68%
Total ash less 10% moisture			3,384 lbs.
Total combustible in ash			789 "
Per cent of total combustible lost in ash			7.64%

Test No. 8.

The object of this test was to obtain maximum horse-power.

Record of Tests.

Number and kind of test.	Test No. 1. Parsons blower with Dutch oven,	Test No. 2. Natural draught with Dutch oven,	Test No. 3. Parsons blower without Dutch oven,	Test No. 4. Parsons blower without Dutch oven,	Test No. 5. Parsons blower without Dutch oven,	Test No. 6. Parsons blower without Dutch oven,	Test No. 7. Parsons blower without Dutch oven,	Test No. 8. Parsons blower without Dutch oven,	Test No. 9. Natural draught with Dutch oven,
Kind of fuel	Bit. coal.	Bit. coal.	Bit. coal.	Slate.	Slate & Braize.	Braize.	Slate & Braise.	Bit. coal.	Bit. coal.
Duration of test (hours)	8	8	8.1	8⅓	8.25	8	8⅙	8	8
Grate surface (square feet)	52.5	56	56	56	56	56	56	56	56
Water heating surface (square feet)	2875	2875	2875	2875	2875	2875	2875	2875	2875
Weight of coal as fired (lbs.)	10000	7875	11800	16400	17400	14400	15800	15800	11400
Percentage of moisture in coal	3.45	1.22	2.85	7.91	4.75	5.60	3.27	2.82	2.62
Total weight of dry coal consumed (lbs.)	9655	7779	11464	15119	16574	13594	15283	15355	11101
Total refuse actually obtained (lbs)	650	500	810	3261	2587	3007	3760	850	1035
Total ash calculated from chemical analysis (lbs.)	481	326	382	4894	3410	3888	4961	537	663
Water fed into boiler (lbs.)	75222	55526	93928	82784	88356	77610	93132	128952	68854
Water to boiler as condensed steam from injector (lbs.)	6171	4524	7800	6870	7547	6435	7794	10185	5735
Total water evaporated (lbs.)	81393	60050	101728	89654	95903	84045	100926	139137	74589
Factor of evaporation	1.1015	1.1043	1.1022	1.1024	1.099	1.102	1.1018	1.1072	1.1023
Equivalent water evaporation from and at 212° F. (lbs.)	89654	66313	112125	98835	105397	92618	111200	154052	82219
Dry coal consumed per hour (lbs.)	1207	972	1415	1814	2009	1699	1871	1919	1388
Dry coal per sq. ft. grate surface per hour (lbs.)	23	17.4	25.3	32.4	35.9	30.3	33.4	34.3	24.8
Water evaporation per hour from and at 212° F. (lbs.)	11207	8289	13842	11860	12775	11577	13625	19256	10277
Water evaporation per hour from and at 212° F. per square feet water heating surface (lbs.)	3.9	2.9	4.8	4.1	4.4	4.0	4.7	6.7	3.6
Average steam pressure by gauge	106	104	104	105	104	108	107	108	107
Average temperature of water entering boiler	154	151	153	153	156	154	154	149	153.5
Average temperature of water entering injector	41	39	39	39	39	40	39	40	39
Average temperature of flue gases	580	500	567	592	430	460	435	552	554
Horse-power developed	325	240	401	344	370	335	395	558	298
Water evaporation per lb. of coal as fired (lbs.)	8.1	7.6	8.6	5.4	5.5	5.8	6.4	8.8	6.5
Water evaporation from and at 212° F. per lb. of coal as fired (lbs.)	8.9	8.4	9.5	6.0	6.1	6.4	7.0	9.7	7.2
Water evaporation from and at 212° F. per lb. of dry coal (lbs.)	9.3	8.5	9.8	6.5	6.4	6.8	7.3	10.0	7.4
Water evaporation from and at 212° F. per lb. of combustible (lbs.)	9.8	8.9	10.1	9.8	8.0	9.5	10.7	10.7	7.9

The fuel used was run-of-mine bituminous coal and the start was the same as in test No. 1. During the last hour of the test the fire was cleaned and a new fire built. This fire was then brought back to the same condition as the fire at the beginning. When this point was reached, the test was stopped. The cleaning period was, therefore, included in test. Time required for cleaning, fifteen minutes.

	Moisture.	Combustible.	Ash.
Fuel	2.82%	93.78%	3.40%
Ash	—	30.76%	69.24%
Total ash less 10% moisture			765 lbs.
Total combustible in ash			235 "
Per cent of total combustible lost in ash			1.58 "

Test No. 9.

The object in this case was to repeat test No. 2 to obtain if possible a higher horse-power. This test was made at the suggestion of the boiler house foreman, who thought he could do better than had been done, using the old arrangements. The start and ending were the same as in the first test. During the first four hours the fire was very good, but during the fifth hour clinker began to cover the grate, cuting down the air supply. The damper was opened wider from time to time, until at the end of the sixth hour full draught was on. The bed of fuel then began to pile upon the grate, and remained unburned to the end of the test. Clinker was removed with great difficulty. Time required for cleaning, one and one-half hours. Weight of ash estimated.

	Moisture.	Combustible.	Ash.
Fuel	2.62%	91.56%	5.82%
Ash	—	60.56%	39.44%
Total ash less 10% moisture			932 lbs.
Total combustible in ash			554 "
Per cent of total combustible lost in ash			5.30%

Flue Dust.

At the end of the tests both of the boilers fitted with Parsons grates were examined for flue dust. The amount found was very large. In the boiler without the "Dutch" oven flue dust was found to extend above the lower tubes. This boiler had been running one month without cleaning. An analysis of the flue dust gave the following:

Combustible	58.60%
Ash	41.40%
Sulphur	1.95%

Very little flue dust was found in the unaltered boiler.

Conclusions.

Tests No. 1 and No. 2 showed the Parsons system was ahead in horse-power delivered and in economy, on coal alone.

Test No. 3 showed that the removal of the "Dutch" oven was advantageous both in horse-power and in economy.

Test No. 4 showed that the washer slate could be burned alone on the Parsons system, with apparently better results in horse-power and economy than clean coal with natural draught in "Dutch" oven.

Test No. 5 showed that coke braize alone would keep up steam on the Parsons' system as well or better than clean coal in the "Dutch" oven with natural draught, though not so economically when based on actual combustible. This was all that one could expect.

Tests No. 6 and No. 7 showed that washer slate and coke braize mixed, when properly handled, could be burned on the Parsons system with excellent results, both in power and in economy. Under the conditions, this test decided the adoption of slate and braize as a fuel, and this method of burning them for the whole boiler plant.

Test No. 8 showed the capacity for forcing the boiler after alterations had been made, in case it was necessary to return to coal firing, also the relatively high economy, even under such conditions. Incidentally, it also showed that the trouble frequently found with the coals of this region, namely, slagging badly on the grate, could be entirely overcome by the use of proper appliances.

Figuring on coal at $1.24 per ton, and slate and braize at 50 cents per ton each, on a daily consumption of 63 tons, allowing for an extra man on each shift to handle the increase in refuse, and to help in the additional cleanings, if necessary, and estimating both fuels as equally efficient, the slate and braize showed a saving of over $43 per day over coal under the former conditions. The slate and braize were, therefore, burned continuously until the supply of slate was exhausted, when slack coal was reluctantly substituted for it at an increased cost.

Feed-Water Heating.

By R. T. Strohm.

That the water supplied to a boiler should be heated before being fed is almost self-evident. For it must be plain that for every additional heat unit possessed by the feed water when it enters the boiler there will be required one less heat unit in the evaporation of that water into steam of a given pressure and temperature. Nowadays it is very seldom that steam plants are installed without ample provision for feed water heating.

This practice is economical, which accounts for its wide adoption, for in most cases it makes use of heat which would otherwise go to waste, and thus render no useful service. The exhaust steam from a non-condensing engine is a familiar example of heat waste, since every pound of the steam thus discharged into the atmosphere contains over 1,100 heat units, the greater part of which might have been utilized. Again, the hot gases which are led into the chimney from the boiler flues contain a considerable amount of heat that may be used. It is from these two sources, exhaust steam and chimney gases, that most of the waste heat is obtained for the purpose of heating the feed water.

The economy thus realized is not to be sneered at. The fuel required for evaporation is reduced approximately 1 per cent for every increase of 10° in the temperature of the feed water. Thus, if feed water having an initial temperature of 80° F. is heated so as to have a final temperature of 180° F., there will be approximately 10 per cent less coal required than before.

The theoretical percentage of saving in any given instance depends upon the average steam pressure carried, as well as upon the rise in temperature of the feed water. However, it can be found very readily by means of the simple formula:

$$\text{Percentage of saving} = \frac{100\,S}{H - t + 32},$$

in which S = rise in temperature of the feed water, in degrees F.;

H = total heat above 32° F. in a pound of saturated steam is the average boiler pressure;

t = original temperature of the feed water in degrees F.

The heating apparatus with its necessary piping and installation will cost something, however, so that the theoretical gain as found by the formula will give a percentage of saving somewhat larger than that which will be actually realized. The cost of cleaning and repairs, together with the interest on the first cost of the heating apparatus, combine to lessen the saving. But the margin remaining is still quite large enough to justify the installation in most cases.

Again, there is the question of safety to be considered. There seems to be a quite unanimous opinion that it is not wise to feed cold water directly into a boiler, for the reason that such feeding sets up strains in the boiler because of unequally distributed and suddenly changing temperatures. Attention has already been directed to experiments in which cold water was suddenly discharged upon red-hot crown plates without causing disastrous results; but in spite of this engineers and firemen are accustomed to regard pre-heating of the feed water as being conducive to safety. The mere fact that a boiler withstood the injection of cold water upon its hot plates does not carry complete conviction that the practice may be made general in its application without tempting fate. The steam boiler is a storehouse of so much energy that its attendants are careful, if for no other than selfish reasons, to use every possible safeguard in its management.

In addition to the considerations of safety and economy, feed-water heating is valuable in that it serves to relieve the water of many impurities. The heating of the boiler feed results in a precipitation of the carbonates of lime and magnesia. These substances are thus largely prevented from being introduced into the boiler, and the danger of having them form into sludge on the plates is obviated to a great extent. The result is that

expensive cleaning operations on the boiler are rendered less frequent and its period of uninterrupted service is lengthened. This is often a matter of considerable moment.

The apparatus in which the heat of the exhaust steam is transferred to the feed water is known as a feed-water heater. According to their construction, feed-water heaters may be divided into two general classes. First, those in which the steam and the water are brought into immediate contact so that the heat of the steam is given up directly to the water, and the resulting condensation mingles with the feed water. Second, those in which straight or curved pipes, or coils are used to separate the water from the steam, the heat being transmitted through the pipes.

A better classification of feed-water heaters, however, divides them into two groups, one group including the open heaters and the other group including the closed heaters. In the open heater, as implied by the name, the water to be heated is open to the atmosphere, and hence is subjected only to atmospheric pressure. As a consequence, the water in an open heater cannot be raised to more than about 210° F. at the highest. At this temperature the carbonates are precipitated, but any sulphates present are left in solution.

Open heaters may be either coil heaters or direct contact heaters. In the open coil heater the feed water is contained in an open tank or vessel in which is a coil of pipe through which the steam circulates, and in which it condenses. A heater of this kind is cheap of construction, but it is not a good form, for the reason that the steam is forced through the pipe coils. This causes considerable back pressure on the engine and lessens the engine economy.

The direct-contact open heater, on the other hand, leads both the exhaust steam and the feed water into the same chamber, wherein the feed water in the form of a spray meets the steam and condenses it, being at the same time heated. This chamber is open to the atmosphere, so that any uncondensed vapor may readily escape. The absence of pipes and bends and the provision of a large chamber for the mingling of the steam and water reduce the back pressure to a minimum.

There is a disadvantage, however, in allowing the exhaust steam and the feed water to mix in this way. All the oil entrained by the steam in its passage through the engine is deposited in the heater, and so is in contact with the feed water. To prevent this oil from being pumped into the boiler it will be necessary to filter the feed water or else to use some form of skimming device whereby the oil may be drawn off. Precautionary measures of this character are unnecessary in the case of coil heaters, since there is no mingling of steam and water.

Since the water in the open heater is open to the atmosphere it cannot be forced through the heater into the boiler. Instead the pump must draw from the heater and then force the water to the boiler. Owing to the temperature of the feed water leaving the heater, the pump cannot lift it by suction, and consequently the heater must be placed at a higher level than the pump, so that the hot feed water may flow to the pump by the force of gravity. Likewise, an injector will not work well, if at all, in connection with an open heater, since comparatively cool water is required to give proper action to the injector.

A closed heater is one in which the feed water is not exposed to the atmosphere. Instead the water passes through coils or series of pipes, on its way from the pump to the boiler, and the coils or series of pipes are surrounded by a chamber containing the exhaust steam. Thus the feed water in the heater is at all times subjected to the direct pressure in the boiler. In the closed heater the steam and the feed water do not mingle.

In another form of closed heater the water is contained in the shell, while the steam circulates through the tubes. Both forms are largely used. If the water flows through the tubes there is some danger of filling the pipes with the sediment and the precipitated impurities, whereas, if the water is in the outer shell, there is a much greater area of surface on which the foreign matter may be deposited. The water tube heater may also be depended upon to give a required feed water temperature with a smaller heating surface than a steam tube heater working under like conditions.

Again, the water-tube heater does not require as heavy construction as the steam tube. For, the pressure of the water is exerted on the inside of small tubes, which can readily be made strong enough without adding greatly to their thickness. In case the water is under pressure in the outer shell, it is necessary to make the shell of considerable thickness, because of its greater diameter.

There is yet another class of heaters using steam as the heating agent. This is the live-steam heater. Instead of making use of exhaust steam, however, it uses high-pressure steam direct from the boiler. At first glance it would seem impossible to increase the economy of operation by taking live steam from the boiler to heat the feed water for that boiler. Nevertheless, it has been found by actual trial that there is a certain reduction in the fuel required under these conditions of operation. Just why this is true is not easy of explanation. It is certain, however, that the circulation is rendered more positive and rapid, which is a potent factor in the evaporative economy of a boiler; and further, it does not seem amiss to conclude that the hot feed water is capable of absorbing heat more rapidly than if it were cold. Both of these conditions would add to the economy.

Feed-water heaters using live steam are usually termed purifiers, since they are used for the purpose of purifying as well as heating the water. By the use of live steam a temperature sufficiently high to cause precipitation of the sulphates can be obtained.

In any form of heater there should be ample provision made for easy and rapid cleaning and for the repairs. The deposit of scale-forming materials on the tubes or on the pans and baffle plates will soon reduce the efficiency of the heater. The expansion and contraction, due to changes in temperature, will loosen the tubes in the tube sheets. Hence, the necessity of providing for cleaning and repair. In open heaters in which filters are used, the same precautions should be observed so as to permit change of filtering materials without any unnecessary labor.

The economizer, which utilizes much of the heat that would otherwise escape up the chimney, consists of a large number of pipes located in an enlarged portion of the flue leading to the chimney. These pipes are placed vertically, and are connected at the top and bottom to transverse headers that are in turn connected to longitudinal branch pipes. The water flows through these pipes, entering the tubes nearest the chimney where the temperature is lowest, and flowing in a direction opposite to that of the flue gases which surround the tubes. Thus, the hottest feed water leaves where the hottest flue gases come in contact with the economizer.

The economizer is really but an extension of the boiler heating surface, and it likewise forms an addition to the water space. Thus, there is always at command a large supply of hot water ready to be evaporated, and requiring little heat to raise it to the temperature of vaporization. In cases where a boiler is subject to sudden accessions of heavy loads, the economizer furnishes water which may quickly be converted into steam to meet the demands of the engines.

The installation of the economizer, of course, is a matter of considerable expense, and is not warranted under all conditions. But when it is remembered that the heat passing up the chimney may be from one-tenth to one-half of that generated in the furnace, the advisability of utilizing a part of it becomes apparent. The natural draft of a chimney requires that the gases inside shall be hot. Consequently, the use of an economizer with natural draft may necessitate adding to the chimney height to secure proper draft pressure. With induced or forced draft no attention need be paid to this consideration.

Being located directly in the path of the hot gases, the tubes of the economizer collect soot, which if allowed to accumulate would soon impair the usefulness of the device. Hence, each vertical tube is fitted with an external scraper, which is moved slowly up and down, thus keeping the heating surfaces clean. The interior surfaces may be cleaned by blowing down, or by periodically removing the incrustation by washing out or scraping.

LETTERS ON PRACTICAL SUBJECTS.

A SIMPLE STATIC MOTOR.

I noticed in the ELECTRICAL WORLD for August, Mr. Jenkins' article on a static motor. Enclosed is a sketch of a motor somewhat different from that described by Mr. Jenkins in that there are no brushes in contact with the tin-foil sectors, so that nothing but the friction of the pivots retards the motion. Referring to the illustration, *A* is a disc of mica fastened to the shaft, as

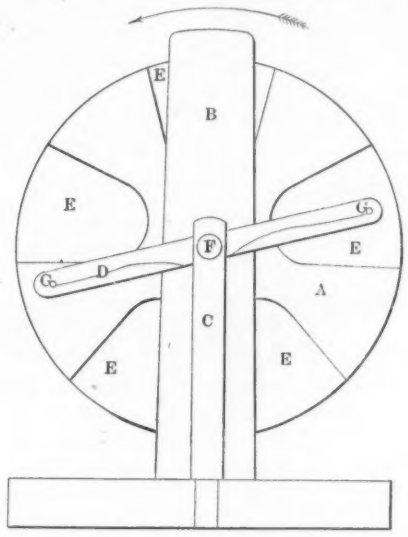


FIG. I.—SIDE ELEVATION OF STATIC MOTOR.

shown at *K*. The shaft is made of two pieces of wood, one of which has a shoulder fitting a hole in the other, and the disc is clamped between them. Five tin-foil sectors, *E E*, are provided and these lap over the edge of the disc on both sides. The disc is 3½ in. in diameter. *B* is a piece of tin bent to the shape shown, the short portion being doubled. The tin is fastened to the wooden base at *J* with a screw, the latter also serving as a terminal for one pole. The longer portion of the tin piece, *B*, has a hole in it large enough to permit the shaft to pass through. Two gramophone needles, *I I*, are set in the ends of the wooden shaft and bearings are provided for each in the brass thumb screw, *F F*. A piece of hard wood, *D*, is set at the angle shown

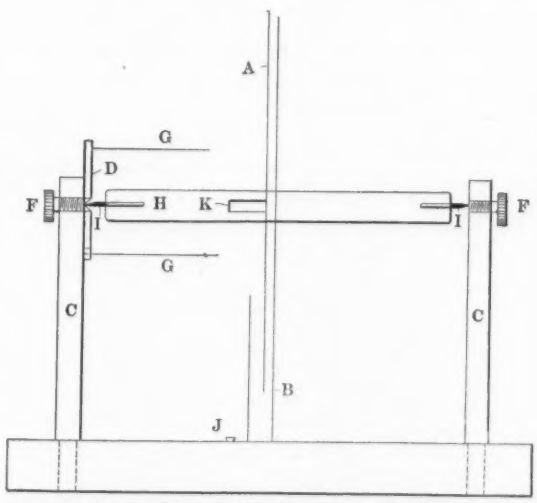


FIG. 2.—END VIEW OF STATIC MOTOR.

to cause the motor to turn in the direction indicated by the arrow. Two wires, *G G*, are set in *D* and make the other terminal of the motor. To operate the motor the terminal, *J*, is connected to a collector under a moving belt, and *G G* is connected to ground through a gap large enough to give a silent discharge. With a potential high enough to jump an air-gap of one inch, a motor of the size specified runs at about 400 r.p.m. To be sure the motor is only an electrical toy, but it might interest some of your readers to figure out how it operates.

MESA, ARIZ. FRANK W. CERNY.

BROKEN FOLLOWER BOLTS.

Why are follower bolts in engines with adjustable pistons so frequently found broken? Is it due to extra hard service, long-continued neglect, or using too much force in screwing them into place? It cannot always be the hard service that makes trouble, because some of them are broken where good conditions exist.

If one or more of these bolts are found badly corroded, or broken off after their strength has been greatly reduced by wasting away of the metal, it is evidence of long neglect, or of extremely bad conditions and perhaps of both. I have always taken the follower bolts out of my engine once each year, examined and put them back, never finding one that was weakened by corrosion. This is at least partly due to the use of first-class cylinder oil, which never gums up the pistons. It is not always possible to tell whether a certain kind of oil will do this or not, but there is one test that does not fail. After one kind of oil has been used for one year and no signs of sediment are found on the internal parts of an engine, it is a good idea to continue the use of it. I have used one kind of cylinder oil in one of my engines for twelve years and have not found a teaspoonful of sediment in the steam chest or the cylinder in all that time. The natural consequence is that when oil agents come around and want to sell me some other kind, I feel that it is wasting both their time and mine to listen, because there is no good reason for changing. I suppose that some of them think I have been bribed by the agent who sells me oil, but I have not, unless it is called a bribe to have oil that lubricates well and gives no trouble.

When I was a very young engineer I screwed the follower bolts in my engine so tight that one of them was broken, but feeling it give way I stopped turning at once, and enough of the metal held to enable me to turn it out, thus saving much trouble. Since then I have made it a rule to turn these bolts in until a perfectly snug fit is secured by good contact of metal, and then stop turning the wrench. By always using the same leverage on these bolts it is an easy matter to give them practically the same tension, and they always come out by giving a reasonable pull on about a 12-in. leverage.

Poor management has caused so much trouble with follower bolts and other parts of adjustable pistons, that engine builders are much more inclined to make them solid than formerly, thus eliminating all follower bolts; but it is impossible to keep the piston rod in line when the piston cannot be adjusted, and therefore after being used awhile, it is turned one-half way around for a time, then turned to let it wear on the other quarters until the rod is below the center in every position, when a new piston must be put in, or the rod allowed to blow steam at every revolution.

When a piston is given one-quarter or one-half of a revolution in a cylinder, it never fits as nicely as it did in its original position, and when it has worn down to another good bearing it is time to turn it again. With an adjustable piston the bull ring can be kept in one place and it soon wears down to a perfect fit. If the lower edges become so sharp that they scrape the cylinder oil off instead of allowing it to lubricate the sliding surfaces, they may be filed slightly at an angle, but do not take off too much metal, as only a little is necessary.

MILWAUKEE, WIS. JAMES JOHNSON.

SCHEME FOR INDICATING CORRECT TIME BY MEANS OF INCANDESCENT LAMPS.

A simple and easy method of setting clocks and watches to the correct time each day is quite desirable in modern life. In this country the correct time is sent to many cities by means of Government telegraphic time signals each day at noon. On the Western Union Telegraph Building in New York City and on the Prudential Building in Buffalo, time balls are provided which drop at exactly twelve o'clock. Comparatively few of the inhab-

itants of cities are enabled to use these signals. The telegraphic signals can only be obtained in places where telegraphic instruments are installed, and the time ball signals can only be seen from certain limited positions and are oftentimes invisible because of dust, smoke, fog and storms of either rain or snow. The writer proposes a new system whereby all the inhabitants of our cities may receive daily time signals correct to a fraction of a second. This system involves the use of all the lamp circuits of a city. At precisely nine o'clock each night the switchboard attendant at the electric light station would open the switch for a moment and all of the lamps on the circuit would blink. The time required by the incandescent lamp in dying from white to a red glow is but a small fraction of a second. Where houses are equipped with electric lamps connected to the central station circuits, the inmates may perceive the signal without even facing the lamps. The method might also be used on passenger trains and steamships equipped with electricity. Thus all passengers might receive the time signal once a day. The attendant at the station may secure the correct time in several ways. He might carry a well-regulated watch which could be compared with the Government's daily telegraphic time signal, or take time from a clock synchronized hourly by the telegraph companies. The scheme presupposes good regulation on all the circuits and in large cities would mean that a large number of circuits would have to be opened at one time.

Buffalo, N. Y. James Asher.

HANDLING ENGINES UNDER DIFFERENT CONDITIONS.

I have had a few days' vacation and utilized some of the time in visiting other plants, as one should improve every chance to learn what other engineers are accomplishing in the important business of steam engineering.

In one plant I found one of the short-stroke, high-speed, enclosed engines that are advertised extensively. The engineer had received orders to run slowly as they wanted to put on a belt in one department. He called in four laborers, who took two levers, and inserting them in the fly-wheel after the engineer had shut down, and turned the shafting slowly and laboriously until the belt was run on; when the signal was given to "Go ahead," steam was turned on, and normal conditions resumed.

It seemed to be a very slow and unsatisfactory process, but how could the engineer help it? He could not see the crank and tell how to shut off and turn on steam to get the required slow speed, and if he could have seen it I do not think that he could have secured the desired results, owing to the short stroke which gives a jerky motion, or stops on the center.

In another plant where there was an engine with a stroke 2¼ times the diameter of cylinder, the engineer received the same order. He closed the throttle valve, waited until the crank shaft was revolving slowly, then turned on a little steam to prevent it from stopping, and let it run so until the belt was on, when he admitted more steam slowly until full speed was secured again. There was no unnecessary delay, and he needed no help.

In still another place the engineer was told to shut down, which he did promptly. After waiting a few minutes he was told to go ahead one-half turn of the crank shaft, and then stop. After another short delay he was ordered to go ahead, and run at full speed as usual. The engine was started and the speed slowly increased until normal conditions were restored. Investigation showed that a large belt had become too loose to carry its usual load. It was taken off and a piece cut out of it. As it went on hard it was tied to the rim of the pulley until it could be barely run on, when it was necessary to stop and take off the rope. If this pulley had been run too far, either the belt or the rope must have been broken.

These details are given just as I found them, not to disparage the short-stroke enclosed engine, but to show that the kind of work to be done should be taken into consideration when deciding on the kind of engine to be used. The use of such an engine as above described does more to prejudice others against that particular type than any written letter could, as that is an object lesson, seen by many and told by them to others.

In another place in the same city they have two of the type of enclosed engines used to run dynamos. They must run for long periods without stopping and here they appear to much better advantage. By a short-stroke engine I mean one in which the stroke does not exceed the diameter of the cylinder.

If the sale and use of one such engine to be used under unsuitable conditions as above described prevents the sale of two or three others for use where they might prove satisfactory, it is obvious that the former sale was unwise. As proof of this I call attention to the fact that manufacturers are their best salesmen; therefore, it must follow that their disappointed customers are a detriment.

If for any special reason it is desired to use a short-stroke, enclosed engine in a mill or shop, friction clutches should be provided at suitable points; then if it is necessary to run one department slow, or stop it altogether, it can be done without interfering with others, and it may also be run one or more revolutions if wanted at pleasure. This will save much time and money by not stopping all departments when only one is out of order.

Pawtucket, R. I. John Downing.

ELECTROMAGNETIC BRAKE FOR RAILWAYS.

Enclosed is a scheme for an electromagnetic brake for railways which is applicable to either one or a train of cars. The apparatus consists of six magnets and a lever fastened under the body of the car, and arranged in such a way as to exert a pressure on the brake shoes through the brake rods, when current is applied to any of the six magnets. As will be evident from the sketch, the pressure on the brake shoes is increased as each succeeding magnet is brought into play in proportion to the length of the long arm of the lever. The brake is intended to be operated from either end of the car by a controller which need not be any larger than the ordinary air brake controller. The current used in the magnets is taken from the motor circuit and the connections may be installed in the same conduit with the

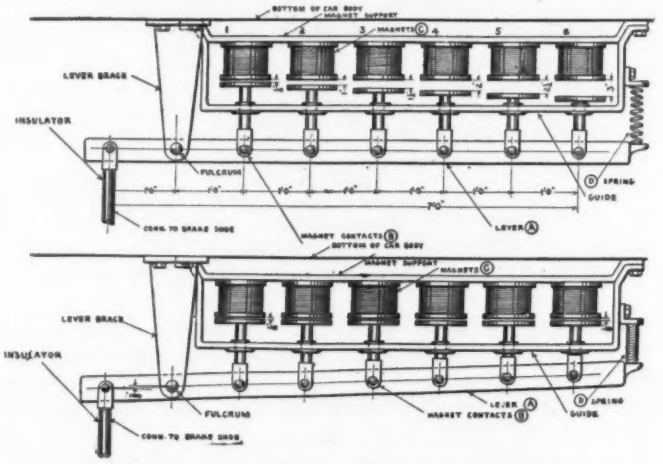


FIG. 1.—POSITION OF MAGNETS WITH BRAKES RELEASED AND APPLIED.

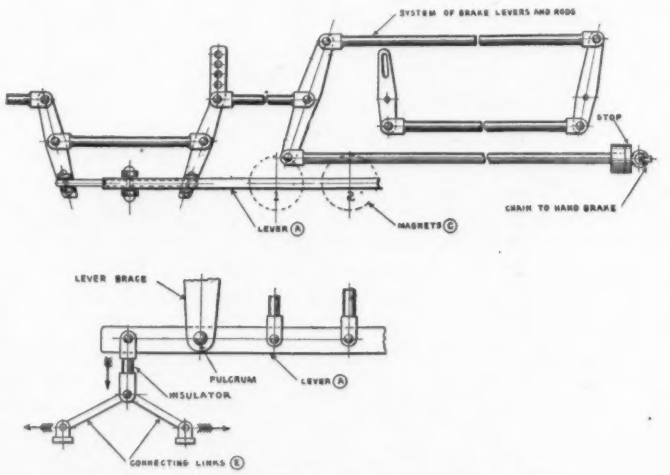


FIG. 2.—ARRANGEMENT OF BRAKE LEVERS AND RODS.

motor connections so that in a multiple unit system the brakes may be coupled at the same time that the other electrical connections are made. The apparatus is, of course, protected from weather conditions and thoroughly insulated from the motor circuits. The braking pressure is graduated by energizing the mag-

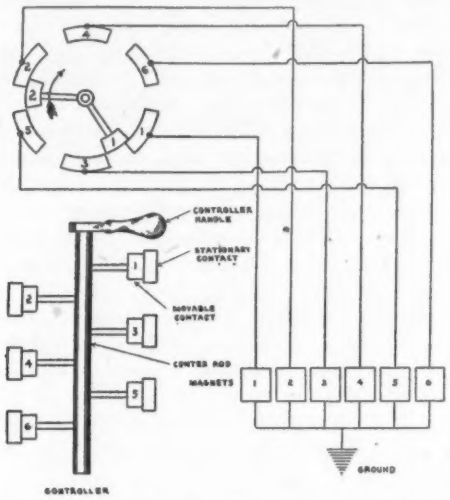


FIG. 3.—ARRANGEMENT OF CONTROLLER AND CONNECTIONS.

nets one after the other along the arm of the lever, the magnets being arranged equidistant from each other. Thus, if a pressure of 2,000 lb. were exerted by the first magnet, the second magnet would exert a pressure of 4,000 lb., the third 6,000 lb. and so on; the pressure being directly proportional to the distance from the fulcrum of the lever. A sketch showing side elevations of the apparatus with the brakes released and with the brakes applied is given in Fig. 1. The pivoted magnet contacts on the lever are arranged directly under the magnets, which are energized when current is applied through the controller. A spring is provided at the end of the lever to keep the brakes normally released. The lever travel at the first magnet is ½ in. and this distance is increased at each succeeding magnet, being 3 in. at the last magnet. This will be made clear by reference to Fig. 1. A plan view of the general arrangement of brake lever and rods under the car, and the method of transforming vertical movement to horizontal movement is shown in Fig. 2, which also shows the connections for the hand brake, and a detail elevation of connections between lever *A* and the connecting links to the brake rods. The circuit

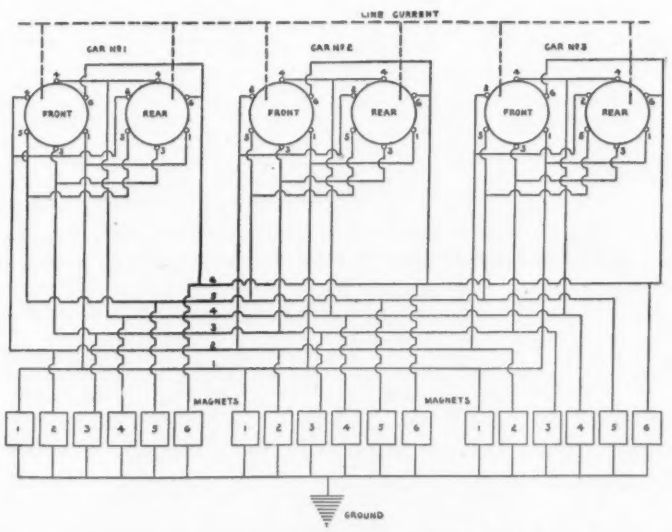


FIG. 4.—DIAGRAM OF CONNECTIONS FOR THREE CARS.

of electrical connections between the controller and magnets is shown in Fig. 3. The controller handle moves through a space of 90° to apply current to the magnets and is intended not to release the current from one magnet until current is applied to the next one, therefore keeping the gap between magnets and magnet contacts at the minimum distance of ⅛ in. The detail construction is similar to the standard type of motor controller.

A diagram of connections between the controllers and magnets of three complete equipments is shown in Fig. 4. This arrangement can, of course, be modified to suit any number of cars and can be arranged to operate the brakes on all cars from any point in the train line. With trolley cars some provision must obviously be made for applying the brakes when the trolley leaves the wire, as otherwise the brakes could not be applied. Fig. 5 shows an

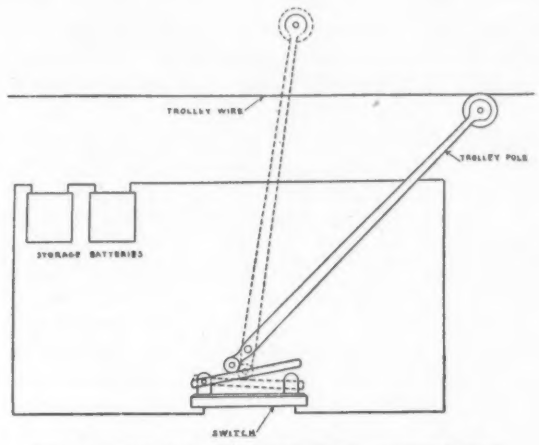


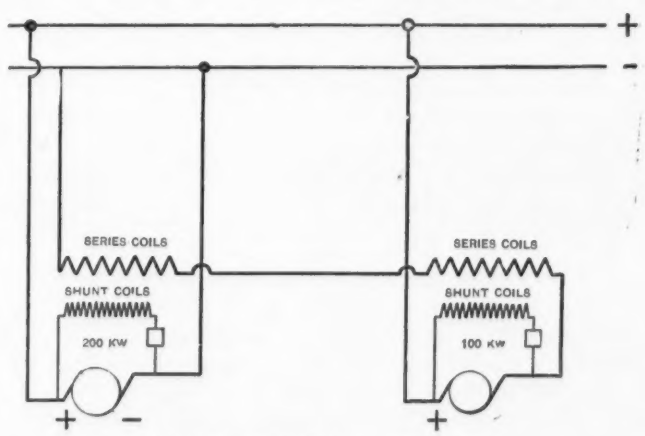
FIG. 5.—DIAGRAM OF EMERGENCY CONNECTIONS.

arrangement of trolley pole, switch and storage battery for such emergency use. The switch at the base of the pole automatically closes the storage battery circuit which is again automatically opened when the pole is restored to the wire.

BROOKLYN, N. Y. C. PARODI.

PARALLEL OPERATION OF GENERATORS.

Some ten years ago the writer had difficulty in operating two 500-volt railway generators in parallel. One of the machines was of 200 kw capacity and overcompounded 25 per cent, while the other was of 100 kw capacity and was undercompounded. Each generator was belted to a separate engine. As it seemed impossible to operate the two generators in parallel in the ordinary way, we having tried to do so a number of times and failed, the writer conceived the idea of connecting the generators as per enclosed sketch. The idea so far as I am aware was original with me, and the circumstances were such that we had to obtain permission from the officials of a large electric manufacturing concern who owned the 200-kw unit before making the connections. They made no objection to our request, but considered it a foolish idea and had considerable fun at our expense; in fact I could get no one to agree with me except the



PARALLEL OPERATION OF GENERATORS.

business manager of my company, and he was not an expert in electrical matters. To make a long story short, we made the necessary connections and found that by adjusting the shunt rheostat we could get any desired proportion of the load on either generator, the two ammeter needles moving simultaneously and showing the same proportion throughout the range of the needles, and this condition would not change until the resistance of the shunt rheostat was altered. The above incident

was brought to my mind by the first question on page 235 of the August 4 issue and signed A. S. M. M. Co. The percentage of compounding can be governed in the same manner as under ordinary conditions.

Montreal, Can. E. C. Prescott.

ECONOMY OF POWER PUMPS.

It is generally understood among engineers and steam users that power pumps are more economical for feeding boilers than direct-acting steam pumps. This conclusion is based on the fact that while the former are driven by power taken from the main engines, which nearly always use steam expansively, and frequently are fitted with modern up-to-date devices by which the most economical results are secured, the latter are fitted with cylinders and valve gears that use steam at a very great disadvantage.

However, it is quite possible to find conditions that reverse these results and make even the wasteful steam pump require less coal than its more favored rival. This letter is written for the purpose of pointing out this fact, for although it is well known to engineers, it is sometimes overlooked by them, while many superintendents and owners of plants who presume to decide what should be bought for various uses, know nothing about the effect of various conditions.

Although the power is produced by economical methods, it may be transmitted by unsuitable means, and the pump located so far away from the engine that the cost of transmission nearly or quite balances the original good management.

Furthermore, water that is heated to a high temperature must flow to the power pump, or else it must pass through a good heater after passing the pump, and in either case utilize heat that otherwise would be a waste product. If neither of these conditions prevail the power pump may not save steam in operation, and at the same time injure the boilers by putting cold water into them.

This was plainly demonstrated a short time ago in a certain plant as follows: Exhaust steam from the main engine was not available for heating feed water, but much hot water was secured by saving the discharge from traps, etc., and under ordinary conditions this was forced into the boilers by a vertical triplex plunger pump, but one day something dropped into one of these hollow plungers, and as the rod vibrated from side to side, this foreign substance became wedged in where it was not wanted, and broke the plunger.

While waiting for a new plunger to arrive, a direct-acting steam pump was used and less coal was burned to carry the same load. Investigation showed that for a portion of the time the power pump received cold or luke warm water, and did not force it through a heater, or else there was no exhaust steam in it. The steam pump took its supply from the same source, but forced it through a good closed heater. Exhaust steam from this wasteful pump was discharged into this heater, raising the feed water to a high temperature, and this accounted for the saving made by what is generally considered a very wasteful machine.

Cambridge, Mass. Chas. H. Brown.

WASTING OIL.

I wish to call attention to a matter which is more important than it is generally supposed to be, judging by the way that it is neglected by engineers and steam users. I refer to the great waste of oil by the use of dilapidated and unsuitable oil cans.

Lubricating oil is frequently kept in 60-gal. tanks, each of which is fitted with a hand pump to raise the oil into a pouring can holding about two quarts. Originally there was a spout on the delivery of this pump, but it is now broken off, consequently the oil comes out in an irregular stream, some of it falling into the pouring can held in that vicinity, while much of it goes back into the tank, until the can is filled when it overflows, the engineer pours out some of it, screws on the cap (if he has not lost it), wipes off the outside with a piece of waste and goes back to his engine.

The only redeeming feature of this operation is that some of the oil goes back into the tank. Some engineers and oilers seem to think that it all goes back, but that is not true. Try it with any thick, viscous engine or cylinder oil and note how much is absorbed by waste in wiping it off from the can. Such a can should have a wide mouth in order to catch all of the oil pumped for it, and the pump should always have a suitable nozzle.

The pouring can used to fill oil cups frequently leaks so that after it has stood for an hour there is quite a puddle of oil under it, all of which is wasted. The nozzle of this can is often too large for the holes in the sight feed oilers, hence some of the oil is spilled on the outside. If the extreme end of such a nozzle is made small enough to go into the holes, and a small collar is soldered on about one-quarter inch back from the end, to prevent the nozzle from going in too far, it will save oil and take less time to fill the oilers.

Some of them leak because the glass body is not properly packed, so that if they are filled at night they will be about one-half full in the morning, showing that much oil does not go where it ought to. In the plant that I have charge of a part of the routine consists of filling the sight feed oilers every night, and if they are not all full in the morning the cause is ascertained and a remedy applied.

Next let us give attention to the squirt cans used in many steam plants. The engineer or the oiler fills one of them, screws on the nozzle and proceeds to oil his valve gear. The first time that he presses the bottom of it oil squirts out around the joint at the base of the nozzle, or comes out of a split perhaps one inch from the end of it. The result is that not more than one-half of the oil disposed of is used to good advantage.

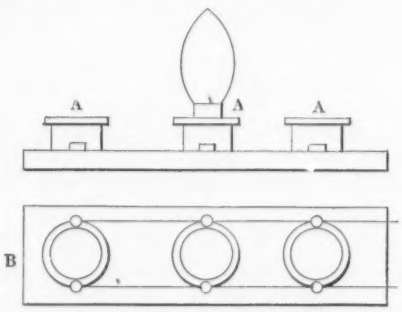
Such a state of affairs is caused by attempts to oil a Corliss valve gear or some other kind while in motion, as it cannot be stopped for this purpose. Sooner or later the nozzle is caught in an oil hole, or between the moving parts and bent or crushed. It would be true economy to throw that can away and the engineer knows it; but if he wants a new one occasionally costing about 20 cents at retail, the owner will consider him careless and find fault with the bills for squirt cans. The consequence is that he continues to use it and before it is finally assigned to the scrap heap, more than 50 cents' worth of oil is wasted through extra holes in it. It would be far better to buy a dozen good squirt cans and tell him to use them as carefully as possible, but when one leaks and wastes oil to throw it away and take another, for as a general rule it is difficult or impossible to repair such a can and make it tight.

Oil that is wasted disappears from sight and is not thought of, but if three or four cheap squirt cans are used in a year they show up to a disadvantage; still it is true economy to use more cans and less oil.

Providence, R. I. Wm. Beadle.

CONVENIENT INCANDESCENT LAMP TESTER.

A very handy arrangement for rapidly testing whether incandescent lamps will burn or not is shown herewith. A piece of



CONVENIENT LAMP TESTER.

board of any desired length is fitted with a number of Westinghouse lamp receptacles, as shown at *A*. The receptacles are screwed to the board, wired and connected up in any convenient place. The lamps are tested by simply inserting their bases in the receptacle. Where a large number of old or discarded lamps

has accumulated, it is desirable to test them before they are sold or given away. Usually there are many good lamps to be found among discarded lamps and for this reason the lamp tester shown will be found an economical and handy contrivance. The number of lamps that can be tested by this means in a given time depends of course on the ability of the person doing the testing, but 15 a minute is a reasonable number. It would be out of the question to test so many if each lamp had to be screwed and unscrewed in an Edison receptacle. While the device is only intended for testing lamps to see whether they will burn or not it may also be used to determine off-hand whether the lamp is worth keeping or not. By inserting a lamp on either side of the testing socket, one of which is of standard candle-power and the other having a candle-power below which it is not desirable to burn a lamp, one can tell at a glance if the candle-power of the lamp under test is below the low candle-power lamp or between the low and the standard candle-power lamp. A plan view of the tester is shown at *B*, and owing to the simplicity of the arrangement further description is unnecessary.

Corona, N. Y. William Kavanagh.

BEHAVIOR OF A BOILER CONTAINING TOO MUCH WATER.

I once had charge of a plant with a 50-hp boiler, which one night gave the fireman some little trouble. The run on the boiler was very light during the day, but just before night it was necessary to get the boiler into full operation so that a 40-hp engine could be started with a rush and about 60 hp of electricity taken from a generator for a few minutes, after which the load fell to 40 hp and remained steady at that point all night.

The boiler was of the horizontal tubular type, without dome or dry-pipe and the water used was not of the best quality by any means. The first time the fireman got up steam, having been fully posted as to the duty required of the boiler, he arranged things so that there would be no hitch. About 40 minutes before the engine was to be started, the fireman had the fire carefully cleaned and the furnace well filled with live, fully ignited coal, all ready for the blast to be put on with the engine. The boiler was filled to the limit with water, and the steam was up to within three pounds of the blowing-off pressure. Thirty minutes before starting time the pressure began to rise. In vain the fireman opened the furnace doors, closed the damper and even opened the doors into the tube chamber in front of the boiler. He could not start the feed-water pump for the boiler was too full already. He could not start the engine and work off steam that way, for the engineer was doing some last bit of work on the engine and had some of the nuts off.

The fireman never thought of opening the blow-off and starting a cold water feed at the same time, so he let the pressure run up two pounds to the blowing point, when Bang! went the four-inch safety valve. One second after the valve opened, the boiler began to foam, then with a boom out came a solid stream of hot water which flashed into steam the instant it reached the atmosphere.

A pop valve is not made to handle superheated water, and the rush of that liquid opened the valve wide and held it there until the boiler pressure fell far below that at which the valve usually closed. For ten minutes, the valve bellowed, and when it finally closed, there was only 100 lb. pressure in the boiler, and very little water. Needless to say the poor fireman had to work very hard to get the boiler in shape again for the load.

Pop safety valves are made so that as soon as the disc rises owing to too high steam pressure, a concave ring catches the escaping steam and serves to add more area to the valve disc without increasing the opening through which the steam issues. This serves to greatly increase the pressure against the disc, and, consequently, to open the valve wider, thereby enabling it to discharge the surplus pressure freely and quickly. When water is blown through a valve of this description, the reaction or increase of area is felt more fully than with the more liquid steam, hence the valve is suddenly thrown wide open and the contents of the boiler came forth in a hurry. It was this which gave the fireman such a bad quarter of an hour when the valve popped with the boiler too full of water.

Chicago, Ill. John Malmken.

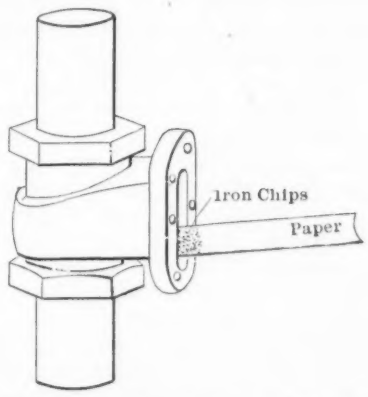
REMOVING BORINGS.

While firing in a planing mill I heard the engineer say that he was going to bore the cylinder and attach an indicator. As this was an interesting matter I watched the process carefully, and noted that although the holes bored into the cylinder contained borings or cast-iron chips, he did not remove them when the drill was about to go through, neither did he take out the piston and remove this iron, but tapped out the holes, screwed in the necessary pipes and started up.

From what is said about such things I thought that less steam would be required after the engine had been indicated, but was surprised to find that it took more than before. Perhaps the valves were not set right, but when that cylinder head was taken off the cause for some of the waste could be plainly seen, as there was a deep groove cut in the bottom of the cylinder for its entire length, and the exhaust valves were badly scored.

Precautions should be taken to remove all such borings or chips and if for any reason this cannot be done, the holes should not be bored.

On another occasion I watched a good mechanic cut a hole in the steam pipe of an engine for a lubricator. He removed the bonnet of the throttle valve and put paper in the body of it to



REMOVING BORINGS FROM STEAM PIPE.

catch all chips falling down. Taking a prick punch he made a mark for the center of the hole, and with a pair of dividers made a circle the right size for its diameter. He then took a peculiar-shaped cold chisel and cut a round hole into which the tap fitted nicely.

All this took no more time than would have been required to rig up a contrivance to hold a ratchet drill, and the work was well done.

When he came to remove the chips I saw the advantage of using paper to catch them, rather than waste, as is customary in many places, because one could tell that all of them were on the paper, but if allowed to fall on a bunch of waste, some of them will fall off while taking the waste out, and they are sure to go where they are not wanted. If engineers would be more careful in such matters they would have less trouble, thus making it pay to take longer and do the work more thoroughly.

New London, Conn. James Brown.

THE EXPECTED WHICH DID NOT HAPPEN.

Since writing about "The Unexpected Which Happened," the writer has had quite an experience which might well be termed "The Expected Which Did Not Happen." A 10-hp induction motor was installed in a factory to drive a certain machine, and considerable trouble was experienced by the frequent blowing out of the fuse in one of the three wires. Although there were three fuses in as many circuits, it was always the same one which blew out, and neither of the other fuses ever exhibited a sign of carrying too much current. The blowing-out always occurred when putting the controller lever into the last notch. Sometimes the fuse would not blow, and again, a fuse would repeatedly let go, even when the motor was allowed to attain full speed before throwing on the running current.

The electricians came, looked the motor over, and departed, leaving the trouble behind them, for the fuses continued to blow

out as they pleased. Soon the "Boss" electrician came, looked wise, and doubled the 20-ampere fuses in each of the three wires, but the alternating current continued to blow out fuses apparently every time the controller happened to be thrown into the last notch when on the tip-top of a wave. Again the head electrician came and looked at things. He removed the doubled 20-ampere fuse wires and put a 75-ampere wire in each of the three leads. We expected fireworks around that motor, Roman candles with pin-wheel attachments, but the expected didn't happen and that motor is running every day as quiet as if taking only 17 amperes at a potential of 440 volts.

Another time when the expected didn't materialize, was when a carpenter was cutting a hole for a door through one of the terra cotta partitions in the Pulitzer Building, and came across a three-wire branch of the Edison circuit. The carpenter coolly gathered the three wires in one hand, his axe in the other hand and prepared to strike, while the writer called to the man to stop, and at the same time hustled out of the way; but the warning came too late. The man cut the wires while I peeped around a book-case, prepared to see all manner of fireworks, and to ring for an ambulance for the carpenter, only to be disappointed, for the wires were severed with a report like a heavily charged shot gun, while the carpenter walked out of the smoke unharmed except for the loss of his mustache and eyebrows, a piece melted out of his axe and his courage entirely shattered.

Equally fortunate was a superintendent of a factory who tried to start a 75-hp, 440-volt, three-phase Westinghouse induction motor on entirely new and original methods. He had been told to throw in the three-pole switch, then to move the controller handle one notch at a time, as the motor acquired speed, until the running notch was reached. Instead of this he forgot to throw in the main three-pole switch, but started the motor all right, worked up the speed to the full number of revolutions, then threw the controller handle into the last notch which should have cut in the running current through the three-pole switch, which alas, had not been thrown into the circuit. Of course, the starting current having been cut off from the motor, that machine at once began to diminish its speed, whereupon the superintendent, noticing the slowing down of the motor, looked around for the cause of the loss of speed and discovered that he had not thrown in the switch. The normal speed of the motor was about 700 r.p.m., and it was probably running about 650 when he discovered that the switch was out. He immediately threw it in, but the knife edge of one phase-line failed to enter its slot and the superintendent promptly pulled the lever back a few inches in order to force the blade into its place.

He pulled the handle back, but he didn't do any forcing, the current did that. A fine arc—three of them at that—sprang from three portions of the switch to three other portions, and the writer expected to see the superintendent killed; but again, the expected failed to materialize. The current only burned the skin off the back of one hand, singed his hair, eyebrows and mustache, melted the contact pieces of the switch and threw the man bodily 12 ft. out of the motor room. There was some filing and scraping done on that switch before it would do its work again, and the superintendent thinks he doesn't need any further instructions on how to start that motor.

A three-horse motor in this same factory proved a trial to the fireman who used the motor for operating a deep-well pump. The well was 195 ft. deep, but the water raised itself to within 40 ft. of the surface of the ground and the pump was used to lift water into a 2,500-gal. tank placed among the rafters of the factory. Once in a while the motor could not be made to start without some one taking hold of the pump belt and giving the motor a "boost"; but once started the motor would run, after a fashion, although not with the "vim" which characterized that machine when in good condition. There was a three-pole knife switch and three fuse plugs on one base, the switch being of the snap-out variety.

The fireman found that late one night the motor would not start, and upon investigation, discovered that two of the fuse plugs had blown out. He put in new plugs, but the motor would not start. It would give off a most distressing hum while the switch was closed, but would not move until a pull was given to the belt, when it would start with the distressing whine noted above. After a while the motor refused to be started at all; the water tank became empty, and the fireman was obliged to draw the fires under the boilers, and shut down the factory.

In the morning the writer started out with a screw-driver and pliers, expecting a tussle with a stubborn motor; but alas for expectations, again they did not materialize. All that was the matter was found on the switchboard which was just 6 in. square. One of the little 5-ampere screw fuse-plugs had failed to screw deep enough into its socket to form connection and arcing at the poles of the switch had melted up a little copper on one of the poles, which prevented the knife from going quite deep enough into its slot. It stopped just so short of its proper position that one of the remaining live wires (one was dead because of the fuse-plug) was put out of business through failure of the knife switch to quite close the circuit.

Boise, Idaho. James F. Hobart.

AUTOMATIC WATER GAUGES.

By automatic water gauges I mean the kinds that shut off water and steam as soon as a glass breaks, and there are several kinds of them now in the market each one different from the others. Many of them are used, but why are they not even more popular than we find them at present? It is not a very pleasant job to climb a ladder and shut the steam and water valves on a common water gauge, with hot water at perhaps 125 lb. pressure blowing out of the lower one and superheated steam coming out of the other. Dry steam will not burn the hand and a shower bath does no particular harm, but we usually like to choose our own time for taking these things, rather than to meet them when we wish to attend to other things.

In a certain plant a short time ago, an assistant engineer opened the drip valve on the water column of one of his boilers that was fitted with an automatic water gauge. When pressure on the glass was relieved by this action the automatic stop valves in both steam and water connections closed, just as they were intended to. When he closed the drip valve, water did not return to the glass as he expected it to, because steam did not leak into the glass and equalize the pressure.

This man had not improved his chances to read the many descriptions of all such devices published in the mechanical papers, hence he did not understand the cause of his trouble, but supposed that there was not water enough in the boiler to be safe. He admitted more steam to his boiler feed pump causing it to run faster, until water ran out of the safety valve, when he became alarmed and proceeded to open the blow-off valve and let the water escape, but still none appeared in the glass. He then sent for the chief engineer (as it was on the night run), who came and opened the automatic valves, showing the correct water level, which was high enough to be safe.

In nearly all such cases the man blames the automatic appliance, whatever it may be, instead of his own stupidity, and never fails to condemn the same on all convenient occasions. This seems to be wrong, for if we fail to understand all appliances used in the plant where we are employed we must expect to have our ignorance exposed sooner or later, and if it is done without causing damage to some of the machinery we ought to be thankful, and at the same time learn to be more thorough in studying up-to-date appliances.

It is bad enough when a glass breaks on a horizontal boiler carrying a low pressure, but when one fails on a vertical boiler where it is much higher above the floor, and the pressure is high, it is much worse. Automatic water gauges require more attention than the common kind, but they are worth more. It is necessary to watch them closely, for if a piece breaks out of a glass near the top and the rest remains in position, water may stand in this part and cause the engineer or fireman to think that it is the true water level in the boiler, when it is not.

If a good globe valve is put into each connection of an automatic water gauge, next to the boiler, it will make it possible for the engineer to shut off both steam and water at pleasure, and examine the automatic valves, thus proving that they are clean and in god order. This is recommended for boilers that are run for long periods without removing pressure from them, although it may be convenient on others also.

Utica, N. Y. S. K. Thompson.

QUESTIONS AND ANSWERS.

Will you kindly explain how to utilize a 54-volt alternating current fan motor on a 110-volt circuit, the motor being a 60-cycle machine and the circuit having a like frequency? T. F. E.

Connect an auto-transformer across the 110-volt circuit and tap off from the middle.

In the August issue of the ELECTRICAL WORLD, under the head of "Practical Inefficiencies," this clause occurs: "But one can at least take accurate account of the water evaporated and thus keep the plant in continuous test." Will you kindly advise me by what means this can be done, and if you can conscientiously recommend any type of water meter which will register hot water under pressure whose price is such that its installation may be economical? C. F. H.

By the use of a water meter, a fairly accurate record of the water consumption may be kept. Water meters are built for this class of service, which are accurate to within one or two per cent. If all the conditions of the service are given, the meters will be calibrated by the manufacturers to meet the conditions .

Is it possible to obtain a voltmeter reading as high as 25,000 volts which does not require a potential transformer? If so, how are such voltmeters made? A. V.

High tension voltmeters are built which have two scales, one reading to 7,500 volts and the other to 25,000 volts. The first reading is taken on the ordinary static voltmeter while the second is obtained by means of condensers located in the base of the instrument. By connecting several condensers in series and shunting one by a static low-tension voltmeter high-tension measurements may be reduced to low-tension measurements, and this is the principle on which the voltmeters mentioned operate.

Is it possible to make holes in sheet iron and iron I-beams by means of an electric arc? If so, how can this be done and what is the voltage of the circuit? R. S.

Yes. Connect the plate or I-beam to the positive terminal of the dynamo and use one or two electrodes connected to the negative terminal having sufficient resistance in circuit so as not to cause a short circuit. The voltage should be about 80 and the current about 200 to 250 amperes. Very heavily smoked glasses should be worn to protect the eyes from the extreme brightness of the arc. With the current used the hands and face should also be protected from the intense heat, especially if the work is to be performed at close range.

We have a water tank several thousand feet from the station and would be obliged if you would suggest some electrical device whereby the height of the water in the tank could be made known in the station. It is impossible to employ a mechanical device owing to the situation of the tank. G. F. M.

Arrange a float in the tank so that it cuts in and out resistance in a circuit as the water rises and falls. The resistance should be buried near the tank so that it will not be affected by the weather and changes in temperature. Place an ammeter in the circuit having the scale graduated to correspond with the position of the float, and for this purpose a vertical edgewise type of ammeter would be preferable. By this means the height of the water in the tank is indicated directly on the ammeter.

When dealing with feed-water and the formation of boiler scale what substance of the many present gives the most trouble? H. W.

Calcium sulphate is probably one of the most obstinate substances found in water with which engineers have to contend. Not only is its presence so frequent but the stony scale formed by it adheres so tenaciously to the boiler that it is with difficulty removed. It is often attempted to purify feed-water by heating it in a separate vessel before passing it to the boiler, and while the temperature of exhaust steam is usually sufficient to throw down the carbonates, the heat of live steam is required for the more or less removal of the sulphates and some time must be allowed for the sulphates to precipitate. Unless this obtains most of the sulphates of lime are carried into the boiler with the feed-water so that the remedy is only partially effective.

Have you any information as to the successful use of electric motors operating large stone crushing machinery? We shall be obliged if you can give us some specific information as to the practicability and economy of such service. If you have not this information at hand, can you advise us where the same can be obtained? G. C. E. L. P. & G. Co.

There is no reason why rock crushers cannot be more economically operated with electric motors than with less efficient steam engines. Where induction motors are employed these should be fitted with heavy fly-wheels. There are a number of electrically-driven rock crushers in use on the Pennsylvania Railroad tunnel in New York City, information regarding which can doubtless be obtained from S. Pearson & Son, the engineers. The Public Service Corporation, Newark, N. J., has also an electrically-driven rock crusher in use at Fairview, which, we believe, is driven by an old street car motor.

I notice in a diagram of motor control connections for street cars that one-half of the resistance is put in series with the motors when they are thrown in multiple whereas all the resistance is in when the motors are started in series. Why is this done? C. D.

The object of using only one-half of the resistance when the motors are put in multiple is to make the drop in the rheostat the same as when the motors are in series and all the resistance is in. With the motors in multiple, each gets half of the line current, and the total current must be twice as great as on the first notch in order to get the same torque. With twice the current, the rheostat resistance must be one-half what it was with the motors in series in order to deliver the same e.m.f. at the brushes and keep the current proportional. If the external resistances were the same in both cases the motors would actually run slower in multiple than in series.

Given the primary current on a 60-cycle 110-volt circuit, what size of wire and how many turns would be required in both the primary and secondary windings of a transformer in order to obtain 10 amperes at 10 volts from the secondary. It is of course understood that the iron core will consist of a closed magnetic circuit with laminated core. C. E. F.

It would be well to use a 10 to 1 transformer, which will give 11 volts on open circuit and about 10 volts at full load. Use No. 19 wire in the primary and No. 9 wire in the secondary, with 10 times as many turns in the former as in the latter. Wind the core with such a number of primary turns that the product of the turns and the cross-sectional area of the core will be 1,070. In this event the magnetic density will be 38,700 lines per square inch, and the core loss will be about 0.9 watt per pound. The current density will be 1,300 cir. mils per ampere at full load, giving a copper loss of about 1.25 watts per pound. A cheaper transformer but one not so efficient can be obtained by using No. 20 wire in the primary and No. 10 in the secondary.

I am engaged in the meter department of an electric light company in the South, and would be obliged if you would advise me, how often, in your opinion meters should be tested. K. B.

Progressive managers of central stations realize the importance of frequently checking up the accuracy of consumers' meters for the purpose of preventing both injustice to consumers and loss to the company. The dust that works into a meter case and the wear on the jewel, all tend to make meters run slow, and if the instrument has a commutator, dirt on the commutator enhances the lagging in speed. In New Orleans the practice is as follows: The meters are, of course, read every month. Every other month the reader takes off the case, cleans the commutator and renews the jewel if he thinks it is necessary. Every six or eight months the meters are checked from a portable meter which is taken to the place by a tester. This portable instrument is checked every morning before starting out. The tester carries in his buggy as many sizes of portable meters as there will be sizes of meters to test on his circuit on that trip. The portable test meter is hung from the case of the meter to be tested by hooks which have turnbuckles in them so that the portable instrument can be levelled. The comparison of the test meter and the consumer's meter at several different loads is done by comparing the number of revolutions of the two meters, which should be the same. The use of the watt-hour meter in this way has an advantage over the use of an indicating wattmeter and stop watch in that it does not require two men to do the testing, and there is less liability to error in observation. In Galveston insects get into the meter necessitating very frequent tests. Moth balls are inserted in the meter cases to keep out the insects and these balls are renewed from time to time.

CENTRAL STATION SALE OF CURRENT

Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under.

Among the papers accorded honorable mention in the competition instituted by the Co-Operative Electrical Development Association was one by Mr. W. Randolph Sweany, contract agent of the Minneapolis General Electric Company. The following are some of the principal points brought out by the paper:

The sale of electricity should be conducted along the same lines as any other manufactured product, and the number of solicitors employed in the new business department, theoretically should be governed by the greatest number that can individually earn a profit on themselves. An organization suggested consists of eight men, all of whom are productive. The contract agent is responsible for the growth of the business, and is assisted by seven others, one general office and publicity man, two special and four district solicitors.

In cities with a population of 40,000, drop out two district solicitors. Where the population is 30,000, drop out two district solicitors and the contract agent, the manager or superintendent assuming the contract agent's duties. With a poulation of 20,000 drop out two district solicitors and contract agent and combine the duties of the power and new building agent with that of the sign and heating, etc., agent. For cities with a population less than 20,000, the manager or superintendent can assume the duties of the contract agent and office man, and the soliciting force be composed of special power and sign, etc., agent, and two district solicitors. If found necessary to further reduce the force owing to limited territory, one or both district solicitors can be dropped, retaining the special power, etc., agent.

The possibilities of a central station company's business are too great to neglect, by curtailing in the soliciting department. If economies must be practiced, first look elsewhere.

The successful contract agent should have a technical and practical knowledge of electricity and mechanics in general, and extraordinary business capacity, combined with a strong personality. He must be able to inspire confidence, not only in the prospective consumer, but in the men under him. It is through this latter channel that he will obtain the best results. His duty is to keep himself and the solicitors abreast of the latest developments in the application of electricity.

The entire contract department should assemble at least two evenings a month, to bring out talking points, review business secured, and talk over new plans; interest must not be allowed to lag. The agent should as far as possible become acquainted with the company's consumers, keep in touch with all civic organizations, new developments and improvements. In addition to supervising the work of the solicitors and publicity department he should personally handle all the large contracts or what might be termed the wholesale end of business. Mr. Sweany then takes up the qualifications needed in the other men in the new business department.

A space in the general office and the show windows should be devoted to displays, demonstrating the different applications of lamps, small motors and heating and cooking appliances; this will greatly assist in making popular devices that improve the day load. A follow-up system of letters, interspersed with attractive folders with cuts and descriptions, will reach people not seen by the solicitors. Such things are bound to create a desire. When this is accomplished the consummation of the trade is left to the solicitors. These letters and folders can be bought from advertising concerns engaged in this line of business at less cost than if designed by the central station company and turned out by local engravers and printers. Such of these as go to consumers can be enclosed with the monthly bill, saving postage. It is best not to be too general in advertising; drive one thing at a time.

In connection with the display part of the business, the central station company should be able to demonstrate the uses of each device it exploits. Although the sign business presents many difficulties, a business arrangement with one or a number of electric sign manufacturers is desirable. It pays to sell signs, heating and cooking appliances, sewing machine motors, etc., from samples shown in the display room.

Only by sticking to system can the best results be obtained. A great many solicitors are prone to hit only the high places. Make a directory for the office, of consumers and prospective consumers. Classify the business. See that all are approached, not once, but many times. Keep a card file of calls and results. Call on the old consumers; find out if they are satisfied; if not, suggest some appropriate change.

For the convenience of solicitors, loose-leaf books that can be carried in the pocket should be provided. These books should contain rules, formulas and data on all subjects pertaining to their business, such as the average consumption of lamps, motors, etc.; percentage of average load to connected load in different businesses, cost of all current-consuming devices, cuts showing the proper distribution of light, etc.

Regarding the necessary forms in the new business department, a check on the solicitors, their calls and appointments, is best kept by the card file system. For the solicitor a calendar is used for appointments. The following form is for calls and results from which is taken a monthly or bi-monthly summary, showing business secured, business lost, its cause and prospective business.

Call Report No..... Date.....19..
Saw M.....Address.....
Previous appointment.....Heard from.....Seen at....
Present installation.....Business.....
Called in reference to .....
.....
.....
.....
Date of next appointment.....
Disposition .....
Complaints .....
Expense incurred.....Collections .....
Agent .....Checked by.....

The remuneration of solicitors should be on a fixed salary basis and not salary and commission. The right sort needs no extra incentive; if he is entitled to an increase and the business justifies it, give it to him; if not, drop him if he is dissatisfied. Either the company or the solicitor gets the worst of it on a commission basis. The interest must be mutual.

It is not meant to refer to rates except to say they are, of course, the largest factor concerned in regulating the amount of new business secured. They should be as simple as possible, published, not concealed, and with the exception of signs and show lighting, which can be placed on a switching circuit under control of the company, they should be entirely on a meter basis.

An Electric Flatiron Campaign in a New England Community of 26,250 Inhabitants.

By J. E. Davidson.

THE Consolidated Lighting Company, which supplies electricity to Montpelier and Barre, Vermont, the former having a population of about 8,000 and the latter 12,000, and also to the towns of Waterbury, Graniteville, Williamstown, East Barre and South Barre, aggregating 26,250 people, has established a reputation, as a small central station, for being one of the most, perhaps the most, successful company in the country, in exploiting electric heating.

The ice was broken—or thawed—for this campaign by hiring

space for a booth, at a fair given by the Ladies' Aid Society of the local hospital. As conspicuous a place as possible was selected for this booth, it being located at the right of the hall and second in order from the entrance. It was about 15 ft. in width and 8 ft. deep, and was a frame structure, consisting of nothing more than upright corner pieces, a roomy counter, and display shelves at the back. A window trimmer was employed to decorate it, white bunting being used generally, and white oilcloth on the counter and shelves, making it one of the most suitably and attractively trimmed booths in the hall. It was wired, not in a temporary manner, but flexibly, and fused sufficiently, so that there could be no mishap whatsoever, and the value of this, when demonstrating, can be well appreciated. It was brilliantly lighted on the inside by Nernst lamps, while in front was left burning at all times a substantially installed electric sign, on one side of which was neatly painted in display form the following notice:

"The Consolidated Lighting Co. will furnish to its customers electric flatirons free for thirty days' trial. If satisfactory, we will sell these irons at cost, viz.: $3.50." On the opposite side appeared: "Coffee percolators, cigar lighters, baby milk warmers, heating pads, chafing dishes and cooking utensils."

As the fair ran two days, two of the leading heating companies were given an opportunity to exhibit their appliances, and were represented by able experts, one make of devices being brought before the public one day, and another the next, which seemed a much better plan than to have a feeling of competition in the air, which the patrons of the booth would come in contact with. On the counter and shelves were quantities of all sorts of heating appliances. As a special feature, coffee was served from four electric coffee percolators that were kept in continuous operation. Coffee, cream, dishes, etc., were furnished and the proceeds from the sale given to the hospital. In a place where it could be plainly seen by all, was a flatiron, connected into a receptacle, with a sign over it, reading: "This flatiron was turned on at ——, and has been burning ever since. You can't burn them out!"

This certainly got in its good work, as the public, as a rule, lays great stress on the fact that the irons have not proved durable in the past, and this went a long way towards converting them. Another sign was in the form of an acrostic spelling "Flatirons," the different lines being fool proof, labor saving, always ready, time saver, ideal, reliable, odorless, neat, simple. The initial letter of the lines forming the acrostic were printed in red.

What attracted as much attention as anything was a complete electric cooking outfit. Steaks were cooked on the broiler, eggs boiled in the cereal cooker, pancakes made on the griddle, potatoes baked in the oven, water boiled on the disc stoves, lobster â la Newburg made on the chafing dish, etc., etc.; and lunches prepared on the electric devices were served to the ladies in charge of the various booths, which, alone, was of great benefit to us.

We did not undertake to sell anything whatsoever at the demonstration, just to pave the way for the future, and it proved to be a well-laid foundation. Our booth was one of the most popular in the hall. We made arrangements with the local newspapers to have the display well written up, which, of course, was the best kind of "ad." The total cost of the demonstration was $37, and the money could not have been spent more advantageously.

For several weeks before that flatirons were put out; we advertised judiciously in the newspapers in the various places we serve. The copy was right to the point, in plain print and well located, and told of our plans, and as the time for delivering the flatirons drew near, we gave the date upon which we would start. Electric signs were lighted every evening in front of our offices, telling of the campaign. In brief, before we commenced putting the irons out, we had the atmosphere so full of them that henpecked husbands would dodge every time the word flatiron was seen or heard—and we kept them ducking all the time.

For delivering and installing the flatirons, we chose one of our best men, from the standpoint of appearance, enthusiasm and ability, and instructed him thoroughly on our plans for placing them.

On May 15 our flatiron man and an assistant, with a wagon load of irons, started the ball rolling. They called on every residence customer we had. The iron was explained thoroughly, preferably to the housewife, and a card was tacked near the place where it was connected, reading: "This electric flatiron is left with each of our customers for 30 days' free trial. If by that time you become acquainted with its numerous advantages, such as convenience, cleanliness, saving of labor, low cost of operation, no hot stove, etc., and wish to purchase it, you can do so at cost—$3.50. Notes.—Regulate the heat by turning current on and off. Temperature and manner of doing work should be the same as that of any other flatiron. Be sure current is turned off when iron is not in use—preferably disconnect from cord. Any electric heating appliance can be obtained from us, free, for trial."

One of the electric heating company's catalogues was also left, having our name and telephone number printed on the front of it, and inside a card reading: "Customers of Consolidated Lighting Company can try any of the electric heating appliances free. We sell them to our customers at cost. Our demonstrator will gladly call at your request."

A complete card index was kept, every customer that was called on having a card on which appeared a complete record—the date he was called on; whether he accepted a flatiron on trial or not; if it was accepted, whether he retained it at the end of thirty days; if it was retained the date payment was made; also if any repairs were made on the flatiron, the date they were made and the nature of the repairs.

The following is a summary of our results to date:

Possible users of irons on lines	784
Customers who refused to take iron on trial	63
Customers who accepted irons on trial but did not purchase	105
Irons sold and paid for	323
Irons still on trial	31
Customers who were using an electric iron previously	32
Customers who will purchase iron later	2

The only way we had of ascertaining the amount earned by the irons was to note the increase in the bills of this year over those of last, and we found that where flatirons had been in use, the bills had increased from $3.11, maximum, to 2 cents, minimum, and on an average of 50 cents per customer.

All summer we have run heating advertisements exclusively in the newspapers.

Our success has fully convinced us that there is nothing to Mr. Small Manager's saying, "Oh, I can't do that in my town, because the people are too poor"; or other excuses, like one I recently read: "Our plant is in the midst of the hard-headed, slow-thinking Germans of Pennsylvania." We might resort to a similar excuse, "We are in New England, where the people are ultra-conservative," but just pound and pound the facts into the public, and just as sure as there is any weight in your proposition, you will drive it home. The conservative New Englanders in our vicinity evidently appreciate the value of electric heating, and have put the old "has-been" irons on the shelf.

Here is our hard-luck story: We have a competitor who gives good service, and, worst of all, sells his energy on low, flat rates. We, of course, have gas competition as well. I don't believe any central station manager can put up a grievance to equal that. We have tried to be very strict about giving or selling any irons to our competitor's customers, but probably some have drifted over onto their lines.

The writer has done all the cooking at his home by electricity since April 25. A watt-hour meter is installed on the cooking circuit, and complete records have been accurately kept to date, giving the consumption of energy for different kinds of meals, cost per person per day, and other data that are instructive, and enables one to talk intelligently on the subject. I believe every central station should have some one actively connected with the management, using electricity for cooking, and, still better, also have some subordinates doing likewise.

In addition to putting out irons, we have placed a great many other appliances. Best of all, we have shown and interested the public in some of the advantages of electricity that are not generally familiar.

Relation of the Alternating-Current Motor to Central Station Business.

In a recent issue an abstract was given of a paper presented by Mr. E. W. Lloyd before the recent meeting of the Association of Edison Illumination Companies. Owing to the timeliness of the subject a reprint in full of the paper is given below:

The bearing that the development of the alternating-current motor has on the securing of power business is greater than generally supposed. It is not the intention to treat this subject in any but a general way, the object of this paper being merely to call to your attention the necessity of the coöperation of central station men with the manufacturers, encouraging them in the design of apparatus that will meet the requirements of customers applying for central station service.

We all run across cases where business was lost because we could not secure motors that would do the work as satisfactorily as the direct-current motor, the margin between the cost of operation of a private plant and central station service being so small that in order to secure the best results from machinery, the manufacturer often decides to install his own plant and direct-current motors with a resulting loss to the central-station company. If we can secure motors that will do the work asked for by the customer, we will help our own cause materially.

With the increase in the capacity of central stations and the tendency towards the generation of alternating current at high potential in large units, it has become possible to furnish power in large stations at a low price to the consumer several miles from these central stations. If this power can be furnished directly from our overhead or underground lines with the use of transformers instead of installing sub-stations, even for large quantities of power, the saving to the central-station companies will be material. Some companies are to-day installing sub-stations on customer's premises, furnishing them power, and standing the loss in transformation as well as the investment involved. The past few years have seen a large increase in the use of alternating-current motors in connection with factory work. This has been largely due to the decreased cost of these motors, the prices now approximating closely prices of direct-current motors of the same sizes and speeds.

Excepting on tools and machinery requiring variable speeds, the alternating-current motor is generally admitted to be a better prime mover than the direct-current motor, owing to its overload characteristics. This motor having been developed to a point where it can be guaranteed as a perfectly reliable prime mover as far as ordinary work is concerned, we are only waiting for the development for variable speed work for factory use. There have been numerous developments on single and polyphase motors for variable speed work by different manufacturers, one company having on the market single-phase motors up to 3 hp that will do variable speed work with very fair results. While, as with the three-phase motor, the operation of this type of motor is not as successful as the direct-current motor, still it is a great step in advance and of the utmost importance to central-station companies.

Already the possibility of equipping cranes and hoists with alternating-current motors has been realized. In Chicago we have several manufacturers using current from the three-phase, 220-volt, 60-cycle system who have their factory equipped with traveling cranes using three-phase motors. These equipments, while not perfect, are reliable enough so that the parties using them are very well satisfied. In fact one large customer, having approximately 700 hp in motors, is changing over a number of traveling cranes from direct-current to alternating-current motors. This is being done in order to save the loss in the changing of the current from alternating to direct through rotary converters. One large alternating-current crane is already in operation, and is proving entirely satisfactory.

We have also equipped several jib cranes with alternating-current motors with satisfaction, being able to handle molten metal in five-ton ladles with perfect safety. One large foundry has several ladles running on tracks equipped with variable-speed alternating-current motors, enabling the operator to tip the same at will, and as easily as if equipped with direct-current motors. For small printing press work we have arranged to install three-phase variable speed motors on cylinder presses, and while we know it is not possible to get the wide range of speed or efficiency possible with the direct-current motor, still the installation is a vast improvement over the old installation or belt drive and cone pulley.

The possibility of equipping alternating-current motors with automatic starting devices is bound to be realized. With this device it is possible to start and stop a motor driving an air compressor from the varying pressure in the storage tank. One company has a starter ready for the market which it will guarantee. With alternating-current motors doing the work described above, the troubles of obtaining power business in larger quantities are to some extent overcome, as one of the most difficult obstacles in the way of obtaining this business was the fact that the alternating-current motor was not capable of giving anywhere near the duty to be obtained of the direct-current motor.

The alternating-current motor has many advantages, namely, its ability to operate under overloads, which would destroy a direct-current motor; it can operate in dirty places without extraordinary attention; its freedom from sparking; and last, but not least, the low cost of maintenance. The direct-current motor has been specialized in many ways and designs, and in small sizes is made to accomplish results economically by the removal of many of the friction losses present in shops where shaft driving was used. The manufacturers of alternating-current apparatus have not as yet made these motors to meet conditions required in individual driving, such as that used in connection with stereotype machinery, printing machinery, bookbinding machinery, or any of the small tools now generally equipped with individual motors, but there is no reason that this cannot be done.

Alternating-current motors equipped with back-gears would find a ready market to-day, as the demand for individual drive on all classes of machinery in factories is more pronounced every day. As near as I can ascertain, there has not been the demand on the manufacturers for variable speeds in these motors as there might have been; the manufacturers being left to do the experimenting, if not leisurely, still not as fast possibly as if the demand had been greater and more urgent. Certain manufacturers of apparatus have refused, not later than a year ago, to manufacture traveling cranes equipped with alternating-current motors, and if it had not been pointed out to them in a forcible manner that their competitors would get the business, they would still be in the same frame of mind.

If our central-station power business is to increase in outlying districts and we are to take care of this business with the same advantages to the customer as in the districts where we furnish direct current, we must have a prime mover that will fit all cases. In our efforts to obtain power business in the alternating-current districts, we find that it is essential that we be able to recommend to our customers elevators that will operate satisfactorily on the alternating-current system without undue disturbance to the pressure on these lines.

There has been a large amount of money and a great deal of thought put into the development of a direct-connected alternating-current electric elevator, but I believe it safe to say that the progress made in the last two years has been greater than in the previous ten, and that the next two years will see even greater advances along these lines. We can now see polyphase motors in connection with elevator service giving excellent results, as the manufacturers are ready to place on the market machines of this type that have been perfected to such a point that their operation is quite satisfactory, the manufacturers stating that the machine takes about double full-load current in starting.

While, as true of other alternating-current motors for regular duty, they are not as good as are direct-current motors as yet, still these motors are very excellent indeed, considering the many difficulties that were necessary to be overcome in connection with their design and manufacture. We all know that when the direct-connected direct-current elevator was connected to our lines years ago, many of the companies had serious trouble with their pressure on these lines.

The demand for the alternating-current elevator motor is growing rapidly, and in direct proportion to this demand the design is

becoming better. It is possible to-day to obtain an alternating-current, direct-connected polyphase elevator that is practically noiseless in its operation so far as the motors, brakes and controller are concerned, and as these three sources of noise have been the objectionable feature in alternating-current elevators in the past, we can safely say that an elevator of this type can be secured that is practically noiseless.

I had the pleasure of examining a machine of this type in operation, and it was as free of noise as is necessary, running practically the same as a direct-current drum-type machine. This machine is equipped with magnet control, the main magnets operating directly from the alternating-current circuits. Driven from the worm shaft by a Renolds silent chain is a direct-current dynamo, which is used to furnish current to the acceleration magnets on the controller. Machines of the larger sizes are equipped with this direct-current dynamo, while machines of smaller sizes for apartment house work can be operated with alternating-current magnet controller without the use of direct current, and the elevator companies are prepared to take orders for this class of machine at this writing. The manufacturers have had in operation for nine months an alternating-current motor with alternating magnet control in their shops. They claim that the machine has not had any further adjustment than that which would be required by an ordinary direct-current controller. This machine was also automatically operated by push buttons.

While I did not have the pleasure of seeing this controller in operation, I will say that the alternating-current magnets operated in conjunction with the elevator which was equipped with a small dynamo operating the acceleration magnets did not make a particle of noise. The elevator in question had a speed of 210 ft. a minute. The elevator company promised speeds up to 300 ft. a minute for 1,500-lb. lifts. These elevators are equipped with alternating-current magnet brakes in the same general way as the direct-current elevators. The brake on the worm shaft seemed to work perfectly. In addition to the electric brake, this car was equipped with a device preventing accident to the elevator should there be any phase changes on the line. This device would prevent the operation of the car until the trouble was rectified.

The push-button type of elevator has not, I believe, received the support from central station companies that it should. This type of elevator is in an excellent state of development, and there is no doubt a wide field for its use in apartment buildings in outlying districts. This push-button elevator has been perfected in connection with the polyphase motor to such an extent that it can be operated very satisfactorily, at least good enough for all ordinary purposes. The hoisting part of the apparatus runs very smoothly, and the controlling part of the mechanism is very fine indeed, it being practically impossible to have an accident on this type of machine through any thoughtlessness on the part of the person operating it. Outside of New York, I am not aware that there are any automatic elevators to speak of, even in the largest cities in this country, while in Europe I am told they are quite common.

Taking it altogether, the situation as regards the electric elevator is very flattering indeed. The progress being made is very good and promises to continue. The experiments being conducted in connection with all types of electric elevators cover a large field, and a great deal of money is being spent and many able men are constantly designing new devices for the perfection of this class of elevator.

The progress in the design of single-phase motors in connection with direct-connected elevators has not been as satisfactory as with the polyphase motor. We have one single-phase, direct-connected, elevator on our lines in Chicago which was installed to replace an old 500-volt machine. The old apparatus was used, the motor and controller only being changed. The operation of this elevator, while giving fairly good results to the apartment building, is hardly satisfactory us, as the starting current is about five times the full-load current. When the line is well loaded the effect is not appreciable, but during times when the line is lightly loaded the effect on the lighting system is very noticeable. The motor in getting up to speed makes considerable noise, and even when running at normal speed is more noisy than desirable. The company making it claim they will in a short time be able to place on the market a machine that will act more satisfactorily, but there is room for a considerable improvement before this outfit will approach the smoothness of operation of the polyphase machine previously mentioned.

We hope to see many improvements in the design of alternating-current apparatus, and, as stated in the first part of this paper, we should co-operate in encouraging the manufacturers in making apparatus that will suit all conditions of service. Unless we are prepared to make considerable reductions in the price of energy we must get this class of business by removing every possible waste, increasing the output of each machine and improving the operation of them by the application of devices that can be operated electrically and automatically.

While investigating the progress made in the manufacture of alternating-current elevators, the improvements in the electric traction elevator were brought to my notice, and I thought a word at this time, while somewhat outside of the scope of this paper, might not be amiss regarding high-speed electric elevators for office buildings. To-day in the larger cities the use of electric elevators has increased to a very large extent, so that owners and builders of high buildings seriously consider, and very often favorably, the installation of electric elevators instead of hydraulic. Not only is the first cost less, but the electric elevator has been perfected to such an extent that the smoothness of operation compares favorably with all types of hydraulic elevators, not only for local but for express service either in dry goods stores or office buildings.

The traction elevator has practically solved the high-speed, high-lift, electric elevator problem, and while there will no doubt be many improvements in electric elevators in the future, still this type of elevator is bound to have a great influence in favor of central-station service in office buildings and stores in our large cities, owing to smoothness of running and economy of operation. The traction elevator can be placed either on the roof of a building or in the basement, whichever is the most desirable and economical, taking up little space in either location. The main objection to the traction elevator to-day is that it is not quite as economical in the consumption of electricity as the drum-type of elevator, owing to the very low motor speed and correspondingly large size of the motor. The present motor for this type of elevator has a speed of from 60 to 100 r.p.m. To make a commercial piece of apparatus of this speed, the efficiency of the motor is sacrificed to some extent. Necessarily the size of a motor of this speed is larger than of the standard commercial motor, and the shop and material costs are greater.

Experiments are at present being made with high-speed motors for traction elevator work, and the prospects of obtaining satisfactory results look very bright. If this feat is accomplished it will further reduce the initial and operating cost of the traction elevator.

The drum-type of machine has been improved greatly in the past few years. The magnet control has had a wonderful influence on the smooth running of machines of this type. The electric brake has also been improved, and this type of brake is not only now applied to the worm shaft, but it is also applied internally to the drum itself in such a way that it greatly increases the smoothness of the operation of this type of elevator in stopping, thus permitting the operation of drum types of elevators at high speed, according to the manufacturers up to 400 ft. a minute.

More strenuous missionary work among architects and owners of buildings about to be erected, with information of the proper sort in regard to electric elevators, would go a long way towards increasing the popularity of this type of machine.

The elevator companies are in this position: They are able to build any type of machine, and it makes little difference to them whether or not the customer uses central-station service. It is up to the electric-light companies to take hold of the situation in a methodical manner, obtaining accurate information regarding the cost of operation in different types of elevators. There have been many figures submitted regarding these costs, but I believe the subject will stand closer investigation.

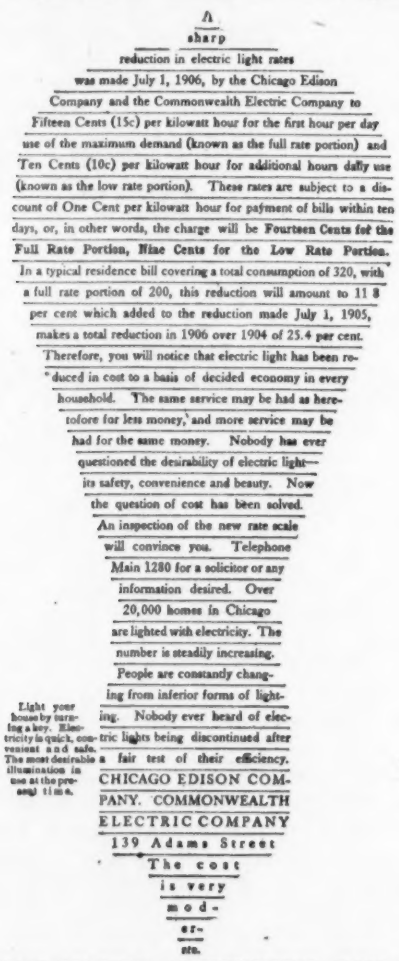
With the advance in the design and manufacture of electric elevators, placing this machine on a high plane, it seems to me that enough evidence could be secured so that we would not be afraid to present the true costs of operation to our customers with great advantage to ourselves.

Flatirons at Grinnell, Iowa.

In a recent issue an article appeared giving some notes on remarkable work done in the introduction of electric heating appliances, especially flatirons, by the Grinnell (Iowa) Electric & Heating Company. Mr. O. K. Cole, manager of the company, now claims the distinction of having in service the largest number of electric irons per capita of any central station in the State. The population is less than 5,000 and 215 irons are out. The last 100 were placed during the three summer months. They were put out on two weeks' free trial. Enough are out to make a pronounced difference between Tuesday morning loads and those of other days. The Tuesday load is about 9 amp. at 1,100 volts, above that of the other week days. The income due to the use of the irons is found to average about 75 cents per month each.

Advertising That Catches the Eye.

Some little while ago we called attention to some of the advertising of the Chicago Edison Company in which the lettering had been worked up into a suggestive form or shape, thus arresting the eye of even the most unobservant readers of newspapers. A better and a quite clever example of this is again afforded in


A
sharp
reduction in electric light rates
was made July 1, 1906, by the Chicago Edison
Company and the Commonwealth Electric Company to
Fifteen Cents (15c) per kilowatt hour for the first hour per day
use of the maximum demand (known as the full rate portion) and
Ten Cents (10c) per kilowatt hour for additional hours daily use
(known as the low rate portion). These rates are subject to a discount of One Cent per kilowatt hour for payment of bills within ten
days, or, in other words, the charge will be Fourteen Cents for the
Full Rate Portion, Nine Cents for the Low Rate Portion.
In a typical residence bill covering a total consumption of 320, with
a full rate portion of 200, this reduction will amount to 11 8
per cent which added to the reduction made July 1, 1905,
makes a total reduction in 1906 over 1904 of 25.4 per cent.
Therefore, you will notice that electric light has been reduced in cost to a basis of decided economy in every
household. The same service may be had as heretofore for less money, and more service may be
had for the same money. Nobody has ever
questioned the desirability of electric light—
its safety, convenience and beauty. Now
the question of cost has been solved.
An inspection of the new rate scale
will convince you. Telephone
Main 1280 for a solicitor or any
information desired. Over
20,000 homes in Chicago
are lighted with electricity. The
number is steadily increasing.
People are constantly changing from inferior forms of lighting. Nobody ever heard of electric lights being discontinued after a fair test of their efficiency.
Light your homes by turning a key. Electricity is quick, convenient and safe. The most desirable illumination in use at the present time.
CHICAGO EDISON COMPANY. COMMONWEALTH ELECTRIC COMPANY
139 Adams Street
The cost
is very
moderate.

A CHICAGO LIGHTING ADVERTISEMENT, HALF SIZE.

the reproduction herewith, showing an incandescent lamp mounted in a key socket. The original advertisement is just twice the size of the cut shown herewith, so that in the newspapers the advertisement is easily read. It will be noticed that each line of the type has a hair line rule beneath it, which not only accentuates it, but without which the advertisement would present a blur of type. The text matter of the advertisement refers very appropriately to the reduction in price of energy made by the Chicago Edison and the Commonwealth Electric Companies, while the matter in the key of the socket is a brief, terse summing up of the advantages of electric lighting by the Edison system. The interesting fact is mentioned that already 20,000 homes in Chicago are lighted by electricity, and that people are constantly changing over from inferior forms of lighting. The telephone number is given for those who desire to make inquiries.

Illuminating a Central Station Show-Window.

The accompanying cut illustrates a show window of the Hillsburg, Tex., Gas & Electric Company. Mr. E. D. Kelly, vice-president and manager of the company, states that the display commenced about three weeks ago and during the same period a half-page advertisement is being run in a daily paper. The display is not only attractive and novel, but also educational.

The window is wired in five circuits, controlled by a flasher, so only one circuit is on at a time. Each circuit burns 30 seconds with a short interval between. The watt-hour meter in the lower left corner with cover removed records the current for all circuits. The light in the green cone shade above the meter is not on the flasher, nor the meter, but burns continually to show the meter stop when all circuits are off. Circuit No. 1 carries the sewing machine motor and the bracket and stand lamp with the parabola reflectors. Circuit No. 2 carries the five Gem lamps, one 250-watt, two 187-watt and two 125-watt. Circuit No. 3 carries two "Hylo" lamps, one bright and one dim, and a cord drop with a knot tied in it with no shade and a black lamp, and a cord drop with two-ball adjuster porcelain shade and a new lamp. Circuit No. 4 carries three tantalum lamps with prism shades. Circuit No. 5 carries three 16-cp, 56-watt lamps, with the same kind of shades.

The heating devices are not in circuit, but the card on each states the price, current consumption and cost to operate. These

CENTRAL STATION SHOW WINDOW.

consist of an electrotherm, two flatirons, pint water heater, a coffee percolator, a chafing dish and a combination series cooker.

This display is in a show window of a millinery store, the company's office not being in the business portion of the town.

As evidence that it pays to advertise, Mr. Kelly states that the regular run of new business was from 20 to 35 orders per month, while in twenty-two days of September, 65 orders were booked and it is expected to reach one hundred by the close of the month. An order does not mean the replacing of a lamp, but means a sale of something to increase the connected load.

The half-page advertisement is well gotten up, and includes handsome cuts at the four corners, and well-written paragraphs pointing out the uses and advantages of many of the devices above mentioned. It is in excellent taste, being entirely devoid of slang.

An Unusual Residence Rate System at Tyler, Texas.

The readiness-to-serve system of charging has been applied in many cities to store and commercial lighting. In few places has it been applied to residence lighting for the reason that the readiness-to-serve charges are so large that they would be objected to by many small residence owners. It is interesting to note that at Tyler, Texas, a readiness-to-serve system has been in force for four years as an optional contract and has been apparently very popular. Mr. A. E. Judge, president of the Tyler Electric Light & Power Company, writes us as follows regarding it:

"The system is somewhat similar to the Wright and Doherty systems. We make a fixed monthly capacity or readiness-to-serve charge and current is billed in addition at 10 cents per kw-hour for all current used up to 2 kw-hours per month per lamp counted, and 5 cents per kw-hour for excess, if any. In residences certain lamps are excluded in counting the lamps connected to secure a basis for the fixed charge, namely, lamps in the front yard, front porch, bathrooms, closets, upper halls, attics, cellars, lamps in excess of two in sitting-rooms and lamps in excess of one in parlors, bedrooms and lower halls. All lamps in connection with the kitchen, dining-room, back lot and stable are counted. The readiness-to-serve charge for residences ranges from about one-half to one-fourth that for commercial lamps for a given number of counted lamps. We have been using the above rate for about four years and now have most of our business on it with very satisfactory results. It almost always follows that a customer's consumption increases very much after going on this rate. We handle our motor business on the same principle and have no other rate for energy."

"The readiness-to-serve charges per month on commercial lamps are 50 cents each for ten 16-cp lamps or less and 20 cents each for all in excess of ten. For residences the charge is 25 cents each for the first four lamps counted and 10 cents each for all counted over four. It should be explained that the popularity of this rate is doubtless due to the fact that the regular meter rates before the readiness-to-serve system of charging went into effect were from 30 to 20 cents per kw-hour."

Letter to the Editors.

Low vs. High Voltage for Lamps.

To the Editors of Electrical World:

Sirs:—I read with much interest an editorial note in your issue of July 14 on 110-220 and 230-460-volt distribution for public supply of energy for all classes of service. I am interested in the question, and in this part of the world where there are no established precedents or standard apparatus, such a matter as this can be decided quite on its merits.

I was disappointed, however, to find that though you have quite a correct resumé of the practice in England and America, you appeared to give your verdict in favor of the custom in the latter country without that close argument of the points which usually accompanies your excellent comments on controversial matters.

You imply that a saving (which I grant without discussion) in consumption in the use of low-voltage lamps more than compensates for the same in capital cost of mains. As a matter of fact, the point at issue is not so simple, and if it were I am not sure that it can be taken for granted that your view is correct. At any rate, I think the most cursory statement of the case should refer to the cost of fuel per unit. I think it is conceivable that in some stations where steam-driven plant is used, highly efficient generation, together with cheap coal, render the fuel item so small that a small saving in this direction would not counterbalance extra capital cost of quadrupling the outside mains, especially where these are underground. (In your note you speak of a saving of half in the expenditure on mains, but this is probably a slip of the pen, since assuming constant copper loss, the sectional area varies inversely as the square of the pressure of supply.) And right here I think lies one reason for the divergence in practice in the two countries.

First, on the average, the cost of fuel per unit is lower in England than in America; and secondly, distribution is more commonly carried out by means of expensive underground mains. I must confess, however, that it would appear that operators of American water-driven plants have not attached importance to such considerations. The argument in these cases seems to be all on the side of economy in mains rather than in generating power. Admitting that the high-voltage lamp is good, but has a disadvantage of, say, 5 per cent in efficiency, it seems forced on one that designers of these plants appear to prefer to save 5 per cent on their generators and transformers rather than, say, 60 per cent on the distributing mains.

The above argument, however, is not quite correct in practice. I do not believe that it is a matter of fact that 220-volt mains are four times the size of 440-volt mains, and the consequence is the efficiency of distribution of the higher voltage systems is considerably greater, and there is a strong probability that theoretically lower cost of fuel per candle-power-hour is pretty well wiped out by the increased loss in mains.

There is also the great saving in the size of conductors for interior wiring which must not be lost sight of, especially in large buildings; for here you must rigidly increase the sectional area of the principal wires four times if you cut the pressure of supply in half.

And lastly, there is the motive-power supply question where there is no counterbalancing advantage whatever in getting as low as 220 volts. In some English towns the power demand is a very large proportion of the total.

Durban, Natal. John Roberts,
Borough Electrical Engineer.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-phase Magnetic Fields.—Lamme.—The author points out that a single-phase magnetic field can be resolved into two fields, each having half the maximum value of the single-phase field, these two fields rotating at uniform speed in opposite directions. He shows how this method of analyzing a single-phase field may be used for the explanation of certain characteristics of single-phase machinery. The suggestion has been made from time to time that direct current could be obtained from a single-phase generator by exciting its field by single-phase alternating current instead of direct current. The author shows the flaw in the argument on which this conclusion is based, and proves that instead of giving direct current such a machine will in reality give single-phase current of double frequency. A simple and interesting general explanation of the action of the single-phase induction motor is then given by the author with the aid of diagrams, by the above method of analyzing the single-phase field, a general knowledge of the characteristics of the corresponding polyphase motors being presupposed. Finally the author makes use of the resolution of a single-phase field into two opposite rotating fields to explain the action of a polyphase motor with wound secondary and collector rings when run with one or more of its secondary circuits open, so that but a single circuit is closed. In this case such a motor will operate at approximately half speed and develop considerable torque. With increasing torque the speed falls off, as in the case of a normal polyphase motor at full speed.—*Elec. Jour.*, September.

Polyphase Current Diagram.—Niethammer.—The first part of a mathematical article, illustrated by diagrams, in which the author shows how his exact polyphase diagram may be systematically applied to all polyphase machines, i. e., generators, motors, converters and regulators. The fundamental formulas for the design of these machines are given.—*Elek. u. Masch.*, Aug. 12.

Calculating Repulsion Motors.—Creedy.—A mathematical ar-

ticle illustrated by diagrams in which the author describes how to proceed in the calculation of a repulsion motor.—*L'Eclairage Elec.*, Aug. 4.

Single-Phase Commutation Motors.—Latour and Richter.—Several communications with respect to the influence of the distribution of the flux over the armature circumference upon the iron losses of a single-phase commutator motor.—*Elek. Zeit.*, September 6.

Iron Losses.—Niethammer.—A translation in abstract, with illustrations, of his recent German paper on the iron losses in alternating-current commutator motors.—Lond. *Elec. Eng.*, August 10.

Power.

Lubrication.—Parish.—A paper read before the Rugby Engineering Society, giving data on the chemical composition and treatment of crude oils, chemical tests, and friction-testing machines. Figures are given showing that in a special instance a reduction of from 7 to 22 per cent in friction was obtained through using a better lubricating oil, while at the same time the cost per week of lubrication was less.—Lond. *Elec. Eng.*, September 7.

Scotch Water Power Plant.—An illustrated description of the Snowdon plant of the North Wales Power & Traction Co. A high-head power with pipe line is utilized to drive Pelton wheels, coupled to 4 three-phase, 1,500-kilovolt-ampere alternators, the frequency being 50, and the voltage of the alternators 10,000. The capacity of the plant is 4,000 hp, and the transmission line is 14 miles long. At present the power is used in three quarries.—Lond. *Elec. Times*, August 23 and 30.

Power Plant.—Dixon.—A continuation of his serial on the planning and construction of a power plant. The author discusses the location and the storage and handling of fuel.—*Eng'g Mag.*, September.

Traction.

Electric Cabs.—Some notes on the financial results in Berlin of running electric cabs equipped with storage batteries of the Hagen Co. The cabs made on the average a daily run of 36 miles, the battery being charged twice, and worked at the following cost: Electric energy, 85 cents per day; maintenance of accumulators, 60 cents; sundry repairs, 25 cents; maintenance of tires, 87.6 cents; total, $2.58 per day. To this must be added wages of driver, costs of administration and depreciation. The most expensive item was the maintenance of tires. The tires first used ran about 3,600 miles. At present the cost is higher, but the tires run 7,800 miles, and the tires on the back wheels of Krieger cars will run 15,000 miles. The cost of maintenance at present is 1.46 to 1.88 cents per car mile. Trials were carried out later by two cab companies in Berlin over a period of 552 days. On account of needed repairs each carriage completed only 517 days. The cars on trial consisted of four victorias and two landaulettes. The mean speed of the victorias was 9 miles (destined for Cologne) and that of the landaulettes 14 miles per hour. The results of these trials have been satisfactory, the average cost over 18,600 miles being as follows: Maintenance of accumulators, 1.042 cents per car mile; electric energy, at 4 cents per kw-hour, 1.458 cents per car-mile; tires, 1.5 cents per car mile; repairs, 0.521 cents per car mile; wages of driver, 3.75 cents per car mile; oil, etc., 0.042 cents per car mile; indirect expenses amounted to: Depreciation, 1.292 cents per car mile; rent, 0.625 cents per car mile; taxameter, 0.1 cent per car mile; office expenses, etc., 2.17 cents per car mile. It follows, therefore, that the total costs per car mile amounted to 12.5 cents. The mean distance run per day was 36 miles, and the greatest distance run on a single charge was 70 miles. With the Berlin tariff, the profit is small. The mean receipts were 43 cents per fare, the mean distance being 2½ miles, to which must be added 1 mile for returning to the depot. Motor cabs were taken for longer distances than ordinary cabs, the average distance for the latter per fare being 2 miles.—Lond. *Elec.*, September 7.

Installations, Systems and Appliances.

Grounded Neutral in a High-Tension Plant.—Ricker.—The Interborough Rapid Transit Co., of New York, operates two steam power stations in parallel, containing seventeen engine-driven and one turbine-driven 10,000-volt, 25-cycle generators of 90,500 kw aggregate rated capacity; and seventeen sub-stations, containing eighty-four 1,500-kw rotary converters, aggregating 126,000 kw. There is a separate lighting system in the subway supplied by three 1,250-kw, 11,000-volt, 60-cycle, turbine-driven generators. The high-tension distributing system consists of eighty-eight 25-cycle, 10,000-volt feeders, containing 308 miles of No. 000 and 13 miles of No. 0000 cable, all operated in multiple, and three 60-cycle, 11,000-volt, lighting feeders, containing 22.3 miles of No. 6 cable. Each of the feeders is a three-conductor, paper-insulated, lead-covered, underground cable, except 1½ miles of three-conductor, No. 000 rubber-insulated, lead-covered, steel-armored, submarine cable. The longest feeders are about 8.6 miles long, and the average length is 3.8 miles. The author points out the difficulties which may arise in such a completely insulated system. In order to prevent, as far as possible, the formation of short-circuits, it was determined to ground the neutral points of all the generature armatures, which are star-connected. The scheme of connections in each generating station is shown in Fig. 1. By interposing a resistance in the lead to ground, the ground current at a fault in the insulation of any single conductor can be controlled or at least damped, so as to allow a maximum flow great enough to open the automatic oil switch in the grounded conductor, but not enough to do serious damage. This arrangement constitutes a complete protection against damage proceeding from breakdowns between single conductors and ground, though none at all against those occurring directly between conductors. As breakdowns to ground appear to be much more numerous, this partial protection is of great value and has been effective in every breakdown since its adoption, except one which was a short-circuit between conductors. In the generators, each phase of the winding is carried

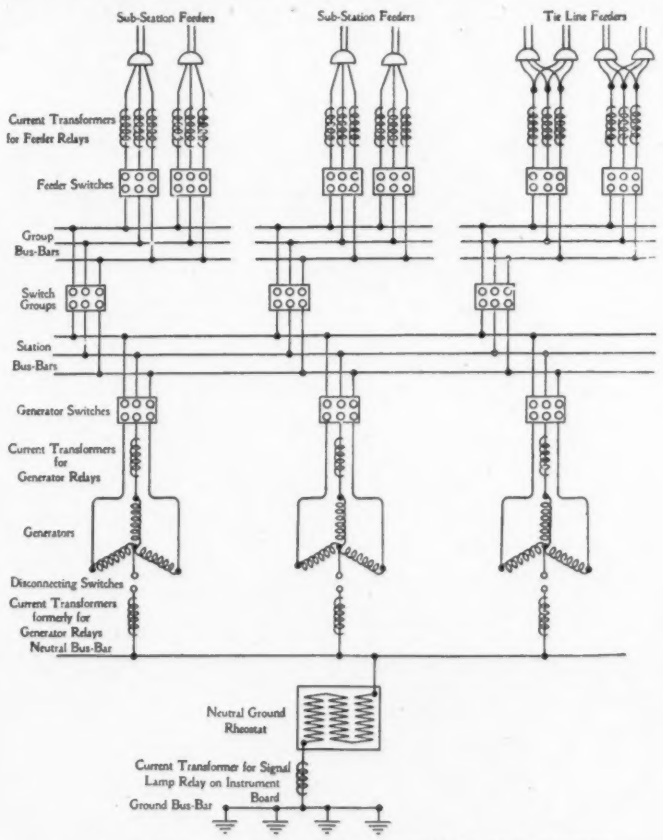


FIG. 1.—SIMPLIFIED DIAGRAM OF GENERATOR CONNECTIONS.

clear around the armature, so that the central point of the star is axially opposite the main leads on the opposite side of the armature. A lead is taken off at this point and connected, through a lever disconnecting switch and a current transformer, to an insulated bus-bar running along the station past all of the generators. Near the middle, this neutral bus-bar is grounded through a rheostat having six ohms resistance. The ground lead passes through a current transformer and is connected at several places to the discharge piping of the steam condenser. The main oil switch of each of the 25-cycle generators is controlled by a triple-pole, bellows type, plain overload relay, all three coils of which are connected to current transformers in

the main generator leads. For several weeks, both power stations were run with all the generators grounded, and with one pole of each generator main switch relay connected to the current transformer in the neutral lead, but several generators were tripped out by the neutral current just after they had been connected to the station bus-bars. Because of the difficulties met in preventing the circuit breakers from tripping the plan was modified and now only one generator at a time in each station is run with its neutral grounded. This system has proven quite satisfactory. The author finally mentions a simple and convenient portable slide wire bridge, with which to locate cable faults. A diagram of the connections is shown in Fig. 2. By

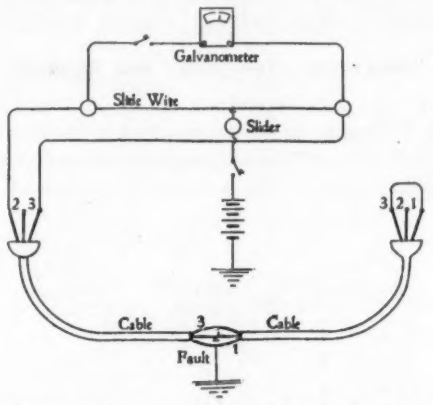


FIG. 2.—CONNECTIONS FOR USE WITH SLIDE-WIRE BRIDGE.

means of a table compiled from the records of the cable department showing the length of each cable and the position of each manhole along it in proportional parts of the total length, the length between the manholes in which the breakdown has occurred, can be picked out at once.—Elec. Jour., *September.*

Grounding the Neutral.—Thomas.—With reference to the system used by the Interborough Rapid Transit Company of New York (see abstract above), the author discusses broadly the advantages and disadvantages of grounding the neutral point of a high-tension system. In certain cases the disadvantages of the grounded neutral far outweigh its advantages, the principal one of which is the prevention at comparatively rare intervals of an extra potential to ground or an oscillation. In many plants such grounds not only cause interruption of service on the grounded feeder, which may be comparatively unimportant, but also cause further breakdowns, perhaps of important apparatus on other circuits and the shutting down of the whole system. It is evident, therefore, that in a distributing system such as that of the Interborough Rapid Transit Company where there are many feeders, any one of which is of comparatively small importance, if it is possible to so arrange the grounded neutral as to open the particular feeder which may happen to be grounded without shutting down the rest of the system, a very great advantage in practical operation will be obtained. By the use of the resistance in the ground wire of the neutral, as described by Ricker, this favorable condition has been approximately secured in the Interborough Rapid Transit Company's generating plants. The complications arising from the use of several generators in parallel are also discussed.—*Elec. Jour.*, September.

England.—Rosenberg.—An article in which the author gives the impressions which he received during the recent visit of German electrical engineers to England. He gives concise data on various English stations, and thinks that in general the stations which they visited show clearly the victory of the steam turbine over the steam engine. Direct-current turbo-dynamos are few, while three-phase machines are built for very different frequencies, but mostly for low frequencies. The visitors did not see much of single-phase installations. The single-phase railroad from London to Brighton will not be opened for several months.—*Elek. Zeit.*, September 6.

Wires, Wiring and Conduits.

Welding Aluminum.—Herkenrath.—Some notes on a new method of Schoop for autogenous welding of aluminum. This difficulty of welding aluminum is due to the fact that in its natural condition it is covered with a very thin and invisible film of oxide. This prevents the successful joining together of the two surfaces. Schoop, therefore, uses a substance which reduces immediately the oxide filament under the flame, so that pure aluminum surfaces are welded together. An illuminating-gas burner is considered to be most satisfactory on account of easy regulation of the flame. The method is thought to be of importance for the use of aluminum as electrical conductor.—*Elek. Neu. Anz.*, August 15.

Middle Wire.—Imbery.—Some notes on the middle wire. The author recommends to occasionally test the local out-of-balance current. In order to do this, ammeter shunts should be placed in the middle wire bar in all the pilot boxes on the distributing mains so that a recording ammeter can be connected in order to discover the out-of-balance current flowing in the middle wire. In this manner it can be easily discovered on which side of the system it would be most advantageous to connect any new consumer. The station and feeder out-of-balance meters may not register any out-of-balance current, but it is quite possible that a large local out-of-balance current may exist on the distributors. This is shown diagrammatically. The author strongly recommends the keeping of the middle wire insulated from the earth, except at the station earth. He finally gives some instructions on tests for leakage on the middle wire.—Lond. *Elec. Eng.*, Aug. 3.

Inductive Capacity of Cellulose.—Campbell.—The conclusion of his illustrated paper on the electric inductive capacities of dried paper and of solid cellulose. The present installment gives an account of experiments with solid cellulose, either air-dried or oven-dried or damp. For air-dried cellulose, the apparent dielectric strength is of the order of 250,000 volts per centimeter, and for oven-dried 500-000 volts per centimeter. Some tests were also made on cellulose acetate, which is now coming into common use as an insulating material for covering thin wires. A sample of normal tri-acetate gave a specific capacity of about 4.7 when dried in air and of about 3.9 when oven-dried. The variation with temperature was scarcely perceptible, being about 1 per cent increase for 40° C.—Lond. *Elec.*, September 7.

Electrophysics and Magnetism.

Radium.—A long editorial on the present radium controversy which was started in English papers by the letter of Lord Kelvin. With respect to the alleged breaking up of radium, it is said that many chemists oppose this explanation and maintain that the whole phenomenon is simply a case of ordinary break-up of a chemical compound. In two most essential points, however, the new phenomenon differs from the old. In the first place the amount of energy liberated is enormously great as compared with that set free in the breakdown of a similar weight of any other known chemical compound, and secondly, the rate of change appears to be unaffected by great heat or by the most extreme cold. —Lond. *Eng'g*, August 31.

Transmutation of Elements.—Bigelow.—A paper in which the author summarizes concisely the main facts which compel us to alter our old definitions of element, atoms, etc., and to show what a strong argument they make in favor of believing in the transmutation of the elements, the divsibility of the atoms, and that what we call matter is simply a mode of motion.—*Pop. Science Monthly*, July.

Electrochemistry and Batteries.

Metallurgy of Silver.—Richards.—A fully illustrated article on a metallurgical revolution in Guanajuato, due mainly to development of cheap power and the introduction of the cyanide process for treating silver ores.—*Electrochem. and Met. Ind.*, September.

Electric Steel.—Stassano.—A paper read before the Congress of Applied Chemistry in Rome on the electrothermal metallurgy of iron. The author describes in detail his work with electric steel, and gives thermochemical data on the subject.—Lond. *Elec.*, September 7.

Units, Measurements and Instruments.

Magnetic Testing.—In last year's report of the German Reichsanstalt it is stated that the magnetic laboratory has completed the comparative examination of the three methods of magnetic tests due to Epstein, Mollinger and Richter, which were formerly described in the Digest. The Association of German Electrical

Engineers has recommended the use of one of these three tests. The conclusion arrived at in 1904—that magnetization tests with direct and with alternating currents gave practically the same results—has been further confirmed by experiments with a magnetically excellent material characterized by very high electric resistance and small Foucault currents. The discrepancy between the results obtained by the two methods of testing seems to depend upon the Foucault currents and upon viscosity. Owing to this viscosity the hysteresis loss per period seems to be influenced by the rapidity of the magnetic reversals, but only for inductions up to $B = 12{,}000$, and up to 50 periods per second. A very thorough research is needed to clear up the scarcely understood treatment. The Associaton of German Electrical Engineers has promised substantial support towards this research, but the metallurgical works have not all volunteered to supply materials, analyses, etc., free of charge. Quite a number of firms, in fact, declined to co-operate or else made their assistance dependent upon conditions which the Reichsanstalt did not see its way to accept, although it undertook to keep the firms interested informed as to the results of the investigation, it being impossible to publish the full official report for some five years or more. Sufficient support has, however, been secured to start the research with the assistance of the metallurgical laboratory of Aachen, and the Government Bureau for Testing Materials near Berlin. The slow magnetic deterioration of certain dynamo iron will also be investigated in the course of the research.—Lond. *Eng'g*, August 31.

Measuring Frequencies.—Schultze.—In the last year's report of the Reichsanstalt a new method of measuring the frequency of high-tension alternating currents is mentioned, which has been worked out by Schultze. When the terminals are dipped a few centimeters apart into a liquid dielectric, e. g., oil, a system of hyperbolic capillary waves is set up, because at the surface of contact of the two dielectrics—the air above the oil forming the second—the substance having the higher dielectric constant tries to concentrate as many lines of force as possible. Each pole produces a system of ring waves; the intersections yield hyperbolic waves which seem to advance with double the frequency of the generator current. When illuminated through a stroboscopic apparatus, the waves will appear to be stationary at the proper speed. This frequency meter, which is said to allow of accurate adjustment, is applicable for high pressures and absorbs but little energy. The waves become visible on petroleum at about 1,000 volts on distilled water at a voltage as low as 150.—Lond. *Eng'g*, August 31.

Ohm.—In the last year's report of the Reichsanstalt, reference is made to the comparison of the mercury units of resistance of the British National Physical Laboratory with those of the German Reichsanstalt. The outcome of this comparison is that the international ohm of the National Physical Laboratory is found to be greater than the international ohm of the Reichsanstalt by +0.00004 ohm. Still better agreement than this could be obtained if the two institutions constructed their mercury standards by the same method.—Lond. *Eng'g*, August 31.

Standard Resistances.—In last year's report of the German Reichsanstalt, it is stated that manganin has, on the whole, given full satisfaction as a resistance material. Some of the manganin coils have been under observation for fourteen years. Of the six which, as ordinary goods, are carried by train from the Reichsanstalt to the six testing stations and back, three have remained unchanged, and three show the very slight increase of 0.0015 per cent, generally noticed in new manganin resistances. It is pointed out that this constancy, the exceedingly low temperature coefficient of 0.001 or 0.002 per cent per degree Centigrade, and the very low thermo-electromotive force against copper, still render manganin superior to all other wire and sheet resistance materials.—Lond. *Eng'g*, August 31.

Cadmium Cell.—In the last annual report of the German Reichsanstalt reference is made to the behavior of the mercurous sulphate of standard cells, which has not yet been fully elucidated, but the long-suspected influence of the size of the sulphate crystals on the electromotive force has been established by Steinwehr. It is only with very small crystals that any such influence is to be expected, and the grains of mercurous sulphate in standard cells are indeed so small that it requires strong magnification to make their crystalline nature apparent. Of two samples of distinctly different sizes, the smaller size gave, in the standard cell, an electromotive force higher by 0.0005 volt than the larger, and Steinwehr hence endeavored to produce both particularly large and particularly small crystals, the latter by mechanical disintegration. The resultant electromotive forces not being very consistent, he heated and cooled solutions of mercurous sulphate in order to make the smaller crystals increase at the expense of the larger. Mixtures always resulted, until means were found of producing none but very small crystals. The influence of size was thus proved; electrical conductivity measurements of the solutions, however, do not support the view that the finer crystals are more soluble than the larger ones; the real cause of the phenomenon, therefore, remains obscure.—Lond. *Eng'g*, August 31.

Telegraphy, Telephony and Signals.

Electric Clocks.—An illustrated article on Bowell's electric clocks which belong to the type in which a master clock closes a circuit periodically for the purpose of actuating any number of indicating dials. Figs. 3 and 4 show the action of the system,

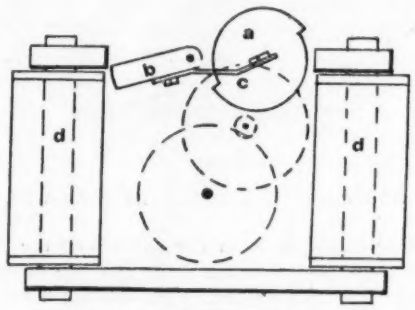


FIG. 3.—ELECTRIC CLOCK.

Fig. 3 being a diagrammatic sketch of the receiver movement, and Fig. 4 that of the transmitting contact in the master clock. In Fig. 3 a rotary armature, *a*, is arranged in conjunction with a reciprocating armature, *b*, these being arranged tandem in the field of the electromagnet, *d*. The armature, *a*, when acted upon by the electromagnet would rotate not quite half a revolution, and the armature, *b*, with its lever, *c*, is therefore provided for the double purpose of completing the exact half revolution of *a* upon cessation of the master clock's signal, and of holding the parts normally in the position shown. The movement of armature *a* is conveyed to the clock hands by gearing. There are no springs or delicate adjustments, and no parts are reciprocated except the armature, *b*, and its lever. The way in which the master clock has its transmitting contact operated is as follows:

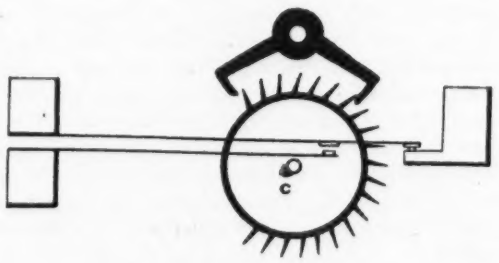


FIG. 4.—ELECTRIC CLOCK.

Fig. 4 shows the escapement which has some of the teeth omitted from the scape wheel. This results in a long run for the purpose of allowing the cam, *c*, to operate the contact springs at the completion of each half minute. The ordinary run or "drop" taken by the scape wheel after the finish of an impulse is kept as small as conveniently possible, because no useful result is obtained for it, but whether the drop is long or short, it does not affect the impulse either before it or following it. The contact arrangement is provided with additional contacts, as shown in the illustration. When the battery circuit is closed these additional contacts cut out the non-inductive shunt; but as the shunt cannot fail to be connected the instant before the battery circuit is broken, this arrangement results in a perfectly sparkless action.—Lond. *Elec. Rev.*, August 3.

Miscellaneous.

Standardization.—Bell.—Under the title, "Wake up, America; Manufacturing Methods which Imperil our Trade," the author emphasizes the paralyzing tendencies of standardized mediocrity. "Labor-saving machinery, interchangeable parts and systematized production have their due place to fill in the world's economy, but they need not become, as they are becoming just at the present time, an excuse for stagnation. They should be the source of manifold lines of progress, and be employed in working out new ideas instead of perpetuating old ones. And above all, they should not be allowed to check the development of the craftsman, who is necessary to the perpetuation of industry. The greatest industrial problem to-day is to maintain the supply of active, intelligent, resourceful American labor in spite of the American system."—*Eng'g Mag.*, September.

Testing Institutions in Switzerland.—Herzog.—An article on the activity of the three testing institutions of the Swiss Electrical Association. There is a committee for inspecting and supervising commercial electrical installations, the safety regulations of the association being obligatory. There is further an institution for testing materials, and a bureau for testing instruments.—*Elek. u. Masch.*, August 5.

BOOK REVIEW.

Polyphase Currents. By Alfred Still. London: Whittaker & Co. New York: The Macmillan Company. 352 pages, 110 illustrations. Price, $2.50.

It may be stated without reservation that the author has thoroughly accomplished the task which he undertook to perform, that is, to produce a book dealing with polyphase currents and polyphase machinery suitable for those who wish to learn about the use rather than the design of polyphase machinery and yet do not desire to have the physical facts obscured by a veil of mathematical formulas as seen from their viewpoint. The treatment throughout is non-mathematical in character, graphical methods being employed for assisting the reader in obtaining a clear understanding of the various interconnected electromagnetic phenomena.

The first two chapters of the book, which treat of alternating currents in general and of self-induction and capacity, are intended to give to the reader a certain amount of familiarity with the use of vector diagrams in the representation of electrical quantities, and this the author has succeeded in doing in a remarkably clear manner with the use of a minimum number of simple mathematical expressions. It cannot be claimed that each statement made is rigorously proved, but the facts are presented in such a way that the reader will be inclined to consider the logical arrangement of the separate statements as adequate proof for the purpose of his information.

The main portion of the book is devoted to an explanation of the operating features of synchronous motors, generators and converters, polyphase circuits and transformers and synchronous motors and generators. To the electrical engineering student and the user of polyphase apparatus the book will prove especially welcome.

D'Arsonval Type Ammeters and Voltmeters.

For accurate electrical measurements instruments based on the D'Arsonval principle have long been given first place, both in laboratory and commercial work. In the past instruments of this type have usually had their permanent magnet system made in several pieces, and to obtain an acceptance scale have had curved surfaces machined to shape, the result being an expensive instrument, depending upon mechanical skill for its accuracy and permanency.

The Troy Electrical Company, Troy, N. Y., is placing on the market an instrument of this type, in which the permanent magnet is made in one piece, and without attached pole pieces, that portion controlling the spacing of the scale being a perfectly flat surface. No drilling, tapping or machine work of any kind is done on the magnet, which is made of the highest grade of tungsten steel, the result being a magnet without fire or water checks and devoid of magnetic contacts leading to error.

The moving element is supported in India sapphire jewels and has a one-piece shaft, which insures a perfect and permanent alignment of the pivots. The damping device—a section of an aluminum plate—together with the coil and index, are so arranged with respect to the shaft that their weights balance each other. The moving parts have a minimum of weight and a maximum of torque, thereby obviating frictional error and rendering the indications dead beat. The resistance for the shunts is an alloy of nickel and copper, which does not become brittle in use, has a negligible temperature coefficient and shows no thermal e.m.f. with respect to the copper of the shunt terminals.

Gas Engine-Driven, Electric Generating Units for Traction Purposes.

Milwaukee, Wis., is being made the southern terminal of a new electric interurban line, known as the Milwaukee Northern Railway, whose contracts for gas engine-driven electric power equipment were recently placed with the Allis-Chalmers Company, of Milwaukee. Messrs. Comstock-Haigh-Walker Company, of Detroit, are the engineers and contractors for the new road and through them the contracts were let, covering what is said to be the largest installation of gas engine-driven electrical generating units for traction purposes in America.

The equipment ordered comprises three horizontal twin tandem gas engines, each with a rated capacity of 1,500 hp, direct-connected to three 1,000-kw, three-phase, 25-cycle alternators, to-

D'ARSONVAL TYPE VOLTMETER.

500-KW WATER-COOLED TRANSFORMER.

gether with gas-driven exciter sets and complete equipments for eight sub-stations.

Port Washington, Wis., will be the present northern terminal of the system, over which cars are expected to be in operation by June, 1907. The main power house is at Port Washington on the harbor front, which provides for economical handling of coal, which can be unloaded directly from the boats at the company's docks, convenient to the gas producer plant.

The power equipment will be of standard Allis-Chalmers design, both for gas engines and alternators. The electrical features of the equipment may be briefly described as follows: Three-phase alternating current will be generated in the power house, at 405 volts and 3,000 alternations, by the three direct-connected alternators. The power house is designed for a future installation of an additional 1,000-kw unit to complete the plant. There will be seven 500-kw, oil-filled, water-cooled, step-up transformers arranged in two banks of three each, with one transformer as a reserve. These transformers will raise the voltage from 405 to a maximum of 22,000, with intermediate taps to allow the voltage to be varied if desired. The current will be carried from each bank of transformers to the high-tension bus through three oil switches, of 40 amp. capacity each, in each cir-

cuit and in addition to plug switches at each transformer to allow for speedily cutting out any transformer in case of breakdown. From the high-tension bus three transmission lines will be led away, each with automatic oil circuit-breakers of 40 amp. capacity in circuit. The station apparatus will be protected from lightning by means of an equipment of low-equivalent lightning arresters and oil-immersed choke coils connected to the high-tension bus.

There will also be installed in the main power house two compound-wound, 300-kw rotary converters connected to a six-panel switchboard having two alternating-current rotary panels, two direct-current rotary panels and two direct-current feeder panels with two feeder circuits, which will contain all the necessary switches, circuit-breakers, instruments, etc., for handling and regulating the current and apparatus.

The rotary converters will be protected from lightning by means of arresters on each feeder circuit and a 50-kw, oil-cooled, three-phase choke coil will be placed in the alternating-current circuit of each rotary in the sub-station installed at the power house only.

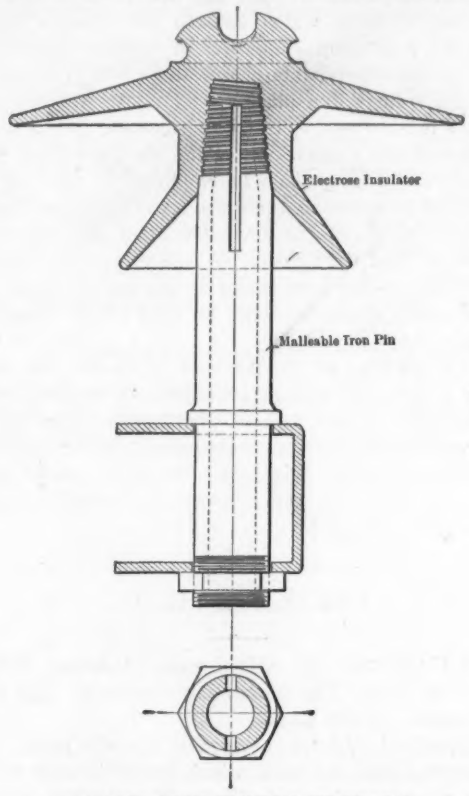
Sub-stations.—There will be eight sub-stations, in each of which there will be placed compound-wound, 650-volt rotary converters and step-down, oil-filled, self-cooled transformers. Each sub-station will be protected against lightning by means of three 22,000-volt, low-equivalent lightning arresters and three 22,000-volt, oil-immersed choke coils; each sub-station will have an eight-panel switchboard having two alternating-current rotary panels, two alternating-current starting panels, two direct-current rotary panels and two feeder panels, except in the Cedarburg sub-station, where there will be three feeder panels.

The low-tension cables are to be triple-braided, weather-proof wire supported on insulators, the insulated covering being relied upon only for protection from accidental contact and as a spacer. All high-tension wires will be bare mounted on proper insulators.

Electrose High-Tension Insulators.

In a paper on the electrical plant of the Canadian Niagara Power Company, presented before the recent annual convention of the Canadian Electrical Association, Mr. Harold W. Buck, chief electrical engineer of the Canadian Niagara Power Company, formerly electrical director of the Niagara Falls Power Company, gave a description of the insulator used on the transmission line to Fort Erie, which line will supply current to Buffalo. The length of the line, which is of 37-strand aluminum of 500,000 cir. mils section, is 15 miles, the voltage being 24,000.

The material of the insulator, which is shown in the accompanying engraving and made by Electrose Manufacturing Company, 127 North Tenth Street, Brooklyn, is "Electrose," an insulating compound which has been largely used in telephone, telegraph and electric railway work, and is now being employed for all forms of high-tension insulation. Mr. Buck states that this material is a very good insulator, is very strong mechanically and is entirely free from cracks and other defects which are common in glass and porcelain. Similar insulators have been used on the Buffalo transmission lines of the Niagara Falls Power Company for the past three years, and they are the only insulators on those lines which have caused no trouble. Mr. Buck adds that it is impossible to shatter Electrose insulators



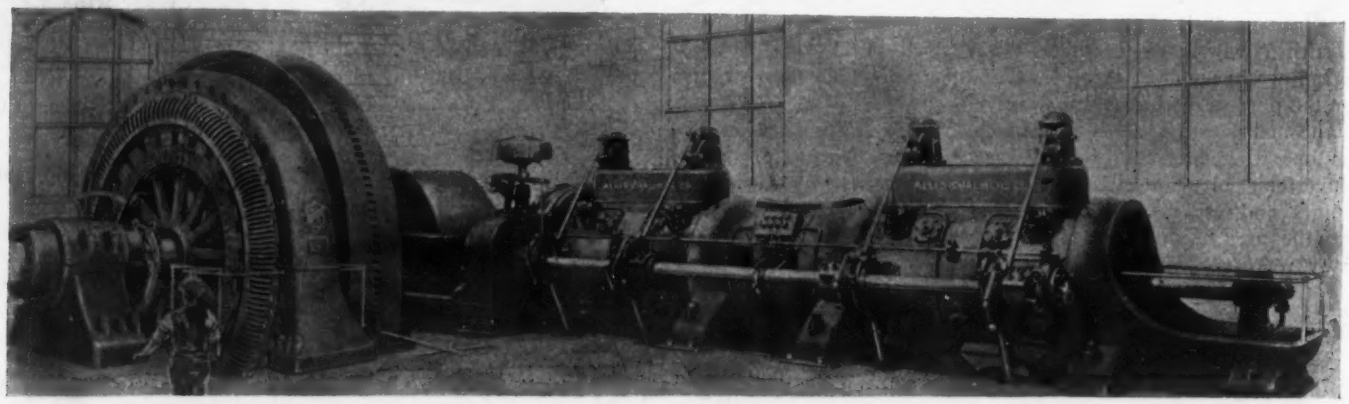
ELECTROSE HIGH-TENSION INSULATOR.

by stone throwing, and they will frequently turn a rifle bullet without being damaged seriously.

The Inverted Bowl Reflector.

Mr. F. W. Willcox, in his recent paper before the Ohio Electric Light Association, called attention to a comparatively new type of reflector called the "inverted bowl." Such reflectors have been available in the smaller sizes for standard incandescent lamps for a number of months. At the present time these reflectors are made in prismatic glass only. The inverted bowl reflector is of considerably more importance to the art of illumination than many realize. In fact, it was not until the manufacturers of large, high-efficiency incandescent lamps took them up as a part of the regular equipment for such lamps, that the electrical trade in general were brought to recognize their merits.

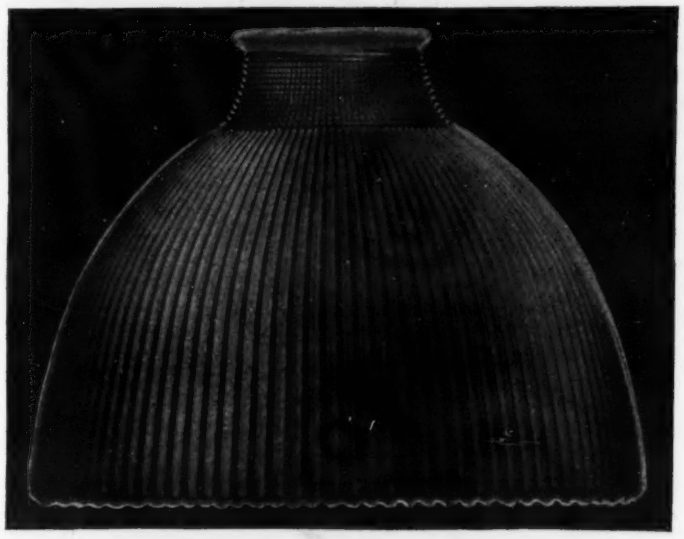
These reflectors have two important characteristics which fit them specially for certain uses. First, they are so deep and come down over the lamp so far, that in many locations they take the place of a diffusing globe as far as diffusing qualities are concerned; and second, they distribute light evenly over a considerable area instead of concentrating it under the lamp at the expense of surrounding areas. The combination of these two



Direct-Connected Gas Engine-Driven Electric Generating Set.

qualities makes this reflector a very important piece of glassware. The peculiarity of the photometric curve from such reflectors is that it has lobes or "wings" something like that from an arc lamp. In other words, the intensity of light from 30 to 40 degrees from the vertical is considerably higher than at the vertical or immediately under the lamp. The practical result of this, of course, is to produce what approximates an evenly illuminated surface under a lamp rather than a surface on which there is a contrast of light and dark areas. There is a tendency, now that there is an awakening to the importance of reflectors, to select reflectors which are too concentrating for the purposes desired in many cases. A very concentrating reflector giving an intensity of from 70 to 120 candle-power directly beneath the lamp with an ordinary 16-cp lamp is a very impressive thing to show a customer in a cleverly arranged dark room so fixed that no account is taken of anything but the light thrown downward. As engineers and users become more discriminating, reflectors giving distributions similar to the inverted bowl are sure to become more popular.

The inverted bowl has been approached in shape many times by glassware of opal, opaline, and the frosted types. The manufacturers of prismatic glassware have apparently been the first to appreciate the practical and scientific value of this design and bring it out as an illuminating appliance, rather than as a piece of chandelier decoration. As far as illumination comfortable



INVERTED BOWL REFLECTOR.

to the eyes is concerned, the inverted bowl is certainly a long advance over the shallow reflector with a frosted bulb lamp. With shallow reflectors on high candle-power lamps, frosting of almost the entire lamp bulb is necessary to give a good diffusion, and even then the intensity is rather high for eye comfort. A lamp in a shallow reflector with only the tip frosted presents a "half done" appearance which is anything but pleasing or likely to commend such lighting units to the public. If frosting cannot cover the entire lamp filament, it might better, as far as appearances are concerned, be left off altogether. With the inverted bowl reflector, frosting of the lamp tip only is effective in hiding the lamp filament, as such frosting cannot be in shallow reflectors. A lamp of much longer life can therefore be used since frosting of a considerable part of a lamp bulb materially shortens the life. The type of reflector, which is illustrated herewith, is made by the Holophane Glass Co., 227 Fulton Street, New York, N. Y.

Storage Battery Plates.

The following brief description of the Gould battery plate and the accompanying illustrations serve to explain to how great a degree this plate fulfills the recognized requirements for lead storage battery plates.

The Gould plate is of the so-called Planté type, in which the active material—lead peroxide of the positive and spongy lead of the negative—is formed electrochemically out of the lead composing the support plate or contact surface.

Fig. 1 shows a fragment of a Gould plate illustrating the manner in which the large contact surface for active material is developed out of a sheet of rolled lead cut to the size and shape of the plate. This "blank" is placed between two shafts on which are mounted sets of rapidly revolving steel discs with spacing washers. These discs are pressed against the plate and moved to and fro, working into the lead further and further and pinning the metal between the knives up into thin parallel ribs.

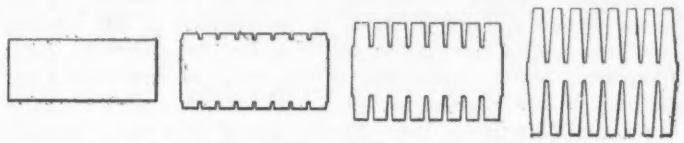


FIG. 1.—PLATE IN PROCESS OF FORMATION.

Fig. 2, which is a longitudinal section of a fragment of a plate, shows the web of metal left as a central conductor and also the diamond-shaped cross conductors and current-distributing bars.

Fig. 3, which is a perspective drawing of a small fragment of finished plate, very clearly indicates the character of the con-

FIG. 2.—LONGITUDINAL SECTION OF PLATE.

struction. The active material is formed out of the lead composing the contact surface between the ribs, filling the spaces with closely packed but highly porous active material. Expansion and construction cannot cause loosening or falling out of

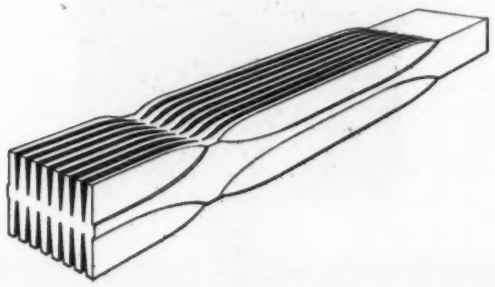


FIG. 3.—FINISHED PLATE.

the active elements and the closest electrical contact is preserved.

Fig. 4 shows the double conducting lug by means of which better distribution of current is secured.

Only chemically pure, densely rolled lead is used, so that secondary actions leading to "self-discharge" are, therefore, impossible. The plate is absolutely integral; no lead is removed

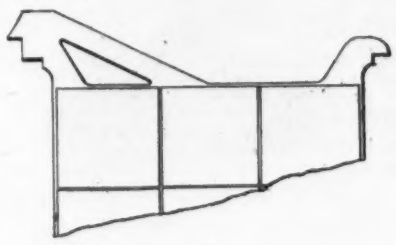


FIG. 4.—DOUBLE CONNECTING LUG.

or added in making the plate—the blank is merely changed in form. The ample provision for circulation of electrolyte and the large contact surface presented secure high efficiency and long life. This type of battery is made by the Gould Storage Battery Company, Depew, N. Y. In addition to batteries for power purposes the Gould company is manufacturing types for telephone, telegraph and signal service, for train lighting and electric vehicles.

Submarine Cable Laying in the Ohio River for Light and Power.

In connection with the reconstruction of the Allegheny County Light Company's plant during the past year, there has been completed a work which is unique in the engineering field in Western Pennsylvania. Since the Brunots Island power station was completed, the light company has had under consideration the question of better services in Ben Avon and adjacent boroughs, and also the supplying of power to West View Park, which opened this season. Owing to the position of the power station and the territory to be supplied, it was deemed unwise to erect a high-tension feeder to Ben Avon through lower Allegheny. After considering several ways of overcoming the difficulty it was decided to lay a high-tension submarine cable under the Ohio River from Neville Island at a point opposite the Ben Avon station of the Pittsburg, Fort Wayne & Chicago Railroad.

After a permit was received from the War Department special cable was ordered from the Standard Underground Cable Company, of Pittsburg. The cable has three No. 4-0 copper conductors, is paper-insulated with an armor of lead and steel. The conductors are covered with a thick belt of paper insulation saturated in ozite, a patent insulating compound. A jute cushion 3/16 in. thick separates the paper insulation from a lead sheath 5/32 in. thick. This lead sheath is wrapped with forty No. 4 steel wires. Owing to its weight and the length required it had to be made in three sections of about 416 ft. long, weighing about 8,320 ft. per section, or 20 ft. to the foot.

As soon as the danger of a spring flood was over a dredge was put to work to excavate a trench about 4 ft. wide by 2½ ft. deep. Blasting had to be frequently resorted to owing to the rocky nature of the river at this point. Cable was shipped by river to the point required, and work was begun at once. Owing to the impracticability of repairing the cable after it is once laid, great pains were taken to make the joints as strong as, if not stronger than, the body of the cable, every caution being taken against a breakdown. After the cable had been paid out, the armor wires were whipped back and the lead sheath removed, the three conductors being spread apart and jointed to the other end of the cable with heavy copper sleeves and soldered. Then a paper tube was placed over each of the copper sleeves and a large tube over all and then laced together. Two large lead sleeves were then placed over this joint, an insulation of ½ in. of ozite being placed between them. After this double joint was made, to make it absolutely safe, a clamp made of cast iron, weighing in the neighborhood of 350 lb. was clamped over the joint by sixteen ¾-in. bolts.

Artistic Electric Portables.

The advance that in recent years has been made in lighting fixtures is illustrated in the accompanying cuts of electric portables made by the Goodwin & Kintz Company, Winsted, Conn.

FIG. 1.—ELECTRIC PORTABLE.

FIG. 2.—ELECTRIC PORTABLE.

Both of the fixtures are made of brass and the ornamentation is all hand-wrought. The finish is in antique green or brushed brass and oxidized black. The shade of the smaller of the two portables is of hand-wrought brass and that of the larger is hand-decorated glass. Other shades, of course, can be fitted to these stands, particularly the larger, as for example art glass designs. The smaller fixture is intended more particularly for use on the dining table or in the library or den.

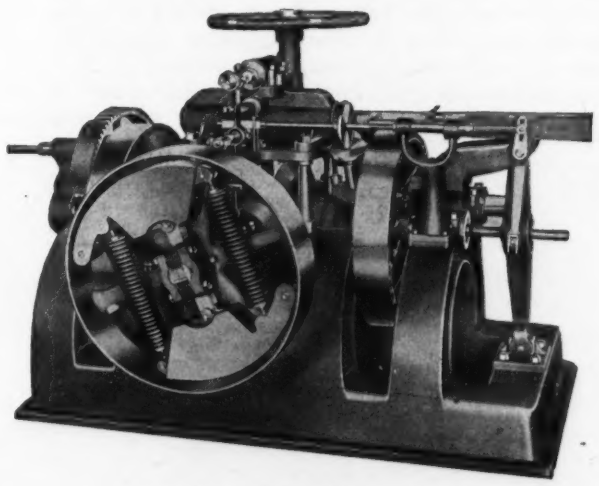
Development of Water-Wheel Governors.

The governor illustrated herewith, which is manufactured by the Holyoke Machine Company, of Worcester, Mass., has now been on the market four years, during which time it has been much improved in its minor parts. Two sizes of governors have been placed on the market; the larger known as the type "A," used for the main units in hydro-electric plants, and the other type "B," for exciter units, and for cotton and woolen manufacturers who wish a close speed regulation at a moderate cost.

The advantages of the improved governor lie in the fact that the time of action may be varied to meet the difficult conditions caused by the action of the water flowing through long feeders. The time required by the governor to open or close the gates can be considered in connection with the proper speed at which the gates should be moved, in order that the gates move no faster than the water will follow under natural conditions. By the use of this timing consideration the tendency to race disappears and the governor may be installed without endangering the feeders by the action of the water, caused by the rapid closing of the wheel gates. The governor is so designed that each type may be made to act in from three to fifteen seconds according to conditions. The type "A" governor is capable of handling the heaviest gates and may be made to exert a pressure as high as 50,000 foot-pounds on the gate shaft.

The governor is provided with a relaying device which is not only simple in construction, but extremely sensitive in action, and adjustable in such a manner as to allow the most varied amount of relaying effect. The adjustments are all of a mechanical nature. When once set they are positive.

The governor is mechanical in its action; power for moving the water wheel gates being taken from two friction clutches, which are thrown in and out by means of a hydraulic piston, supplied by either oil or water at a pressure of 20 to 30 lb., water being preferred. In most cases this may be taken from the local water system.



HOLYOKE WATER-WHEEL GOVERNOR.

The advantages from the use of a low pressure are marked, doing away with the difficulty experienced by the use of oil under high pressure and the necessity of maintaining a vacuum. The speed-controlling element is of a centrifugal type, consisting of a pulley containing a pair of movable weights, the centrifugal force being balanced by springs. The motion of the governor weights caused by the variation in speed is carried to a valve located on the top of the piston, which is used to throw the clutches. When the governor is running at a normal speed the ports in this valve are closed. Any variation in speed causes the valve to admit a pressure to the piston, and in turn the piston throws the clutches as may be required.

The governor is driven with but one belt, and in case the belt breaks the gates of the water wheel will remain where they are. This is not the usual case, the tendency being to open, and often a runaway follows.

The governor may be provided with an electrical control for synchronizing from a distance; also with an automatic stopping device which may be arranged to operate from various points in the plant, and may be used in case of accident.

The company has spared no expense in equipping its governor department with the latest tools and the most up-to-date methods. Every part of this machine is thoroughly jigged throughout. The foreman in charge of the department is a man of great experience in the manufacture of governors, having spent some twelve years on this class of work. The company has now under consideration plans for a larger size of the governor, capable of exerting from seventy to eighty thousand foot-pounds in from three to eight seconds.

Show Window Lighting.

A great deal of rivalry exists between the window dressers of the large department and furniture stores, many of whom are men commanding large salaries for their ingenuity, taste and ability in displaying the various goods to good advantage. It is a well-recognized fact that the most valuable ally these men have is the electric light. It is used in many different ways and great skill is frequently displayed in its application to show window dressing. Probably nowhere in the world is this competition and rivalry fiercer than on State Street, Chicago, where practically every store is so lighted and every window filled with an attractive display. Men who have charge of this kind of work come from all over the surrounding territory to get pointers from the State Street stores, and well they might, for not in years have so many innovations in the method of show window dressing been introduced in so short a time.

A new lighting device called a "poke bonnet searchlight" by the manager of one of the largest Chicago department stores, plays an important part in this display, and will in all probability become an indispensable feature for this kind of work. It is a trough reflector constructed in sections each 14 in. in length, and complete in itself. These units can be combined to give any desired length required, but the light furnished is sufficient for them to be erected at intervals instead of being used as a continuous trough; thus making a saving of one or more lamps

POKE BONNET SEARCHLIGHT.

every 3 ft. It is claimed for this reflector that it will give double the light for the same current or as much light with half the current now used. Each section being separate and independent, it can be adjusted to any desired angle to throw the rays of light where they are most needed. When used in a window they can be placed in the front, back, top or end. When only a few are needed, each reflector may be used as a separate lighting fixture and easily installed by anyone. The adjuster on the stem furnished with each reflector is such that any desired angle may be obtained. Each section is furnished with a nickel-plated twin socket, so that two lamps of any desired candle-power may be used according to the volume of light required. The reflector can be easily and frequently washed without injury, and it is claimed that four will light a 12-ft. window with great brilliancy. The concern manufacturing them is the National X-Ray Reflector Company, of Chicago.

The Temple-Ingersoll Electric Air Drill.

The accompanying illustrations show a new type of drill employing electricity in its operation, known as the Temple-Ingersoll electric air rock drill, and made by Ingersoll-Rand Company, New York. While not an electric drill in the usual sense of that term—the piston which carries the bit being thrown back and forth by air pressure—the power which operates the drill comes from an electric generator and all the power is transmitted to each individual drill by wire.

Referring to the illustrations, there is a drill cylinder mounted to slide in the usual shell and moved back and forth therein by an ordinary feed screw. The shell is mounted on tripod, bar or column in the usual way. The drill piston carries the rock cutting bit attached to the end of it by a chuck special to this drill. Accompanying each drill and an essential part of the

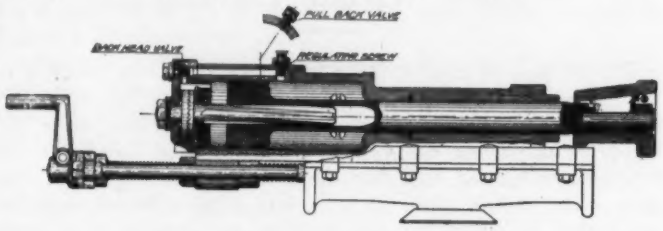


FIG. 1.—SECTION OF ELECTRIC AIR DRILL.

apparatus is a small truck which carries an electric motor geared to a shaft which carries two cranks 180° apart. These cranks alternately reciprocate the single-acting trunk pistons of two small vertical air cylinders. One of these air cylinders is connected to one end of the drill cylinder by a short length of strong and unelastic air hose, the other end of the drill cylinder being similarly connected to the other air cylinder on the truck by another hose. In each hose, therefore, and the parts to which it is connected, the same body of air remains constantly and the two separate portions of air in the separate lengths of hose have no communication with each other.

The operation of the drill is quite simple. At the beginning there is a normal pressure in both hose, both air cylinders and on both sides of the drill piston of, say, 30 lb., so that there is no tendency of the piston to move in either direction. As the

FIG. 2.—DRILL IN OPERATION.

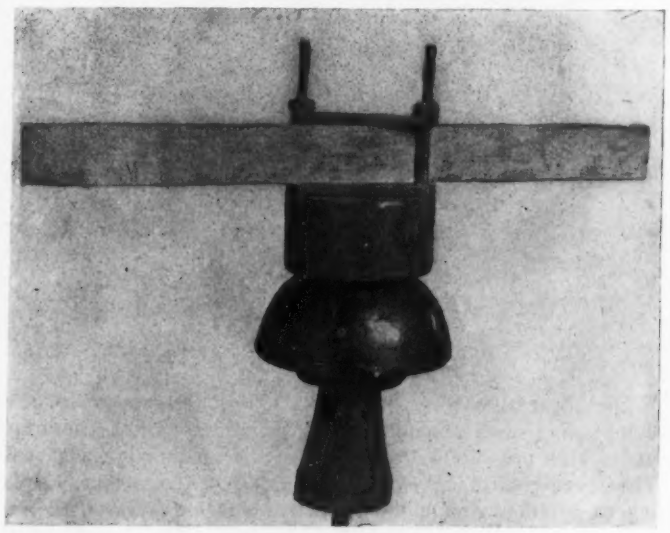
crank shaft turns one of the pistons advances in its cylinder and the pressure rises there and also on that side of the drill piston. At the same time the other compressor piston recedes in its cylinder and the pressure on its side of the drill piston is diminished, the difference of pressures resulting thus causing the drill piston to make its stroke. Before the drill piston reaches the end of its cylinder the action of the compressor pistons is reversed and in this way the piston is caused to make a stroke and return for each rotation of the compressor crank shaft. As the motor rotates with a practically uniform motion the strokes of the drill are regular, rapid and continuous.

The air compressor may more properly be called a pulsator, since its function is not only to increase the air pressure, but also equally to reduce the pressure for each complete stroke. When the drill is running the piston does not strike the cylinder heads, but is cushioned by a considerable body of air, and the elasticity of this air starts the piston on its return stroke with a highly effective pressure from the very beginning, and the accelerating movement of the crank-driven piston in the pulsator cylinder makes this an increasing instead of a declining pressure for more than half the stroke or almost until the actual blow is struck. On the other side of the drill piston at the same time not merely a reduced but a still diminishing pressure is encountered, on account of the crank acceleration of the retreat of the pulsator piston in the other air cylinder, this accelerating augmentation of pressure on one side of the piston and the diminution of pressure at a corresponding rate on the other side combining to give most rapid movement to the piston and its bit right up to the striking of the blow.

It is claimed that this drill will do the same work as the regular air-operated drill on an expenditure of one-quarter to one-fifth of the power. Either a direct or an alternating-current motor may be used, the latter being preferred. The direct-current motor is arranged for four speeds and the alternating motor for two—full speed for regular running and part speed for starting a hole or for working through bad ground. The controller is on top of the motor, a strong cord reaching from it to the drill, and the motor is started, speeded or stopped by pulling the one cord. The electrical connections end completely at the motor, the hose is a perfect insulator and it is not possible for the drill runner to be shocked.

Bus Bar Insulator.

A new bus-bar insulator made by the Locke Insulator Manufacturing Company, of Victor, N. Y., is illustrated herewith. It is one of those useful things that when an engineer wants he wants very badly, and he often has to spend a good deal of time and money in getting up something of his own for the purpose. It will be noted that the insulator is mounted on the pin at the bottom and on top of the insulator is a cast-iron cap. Above this is a wrought-iron strip secured by a pivot at its center to the



BUS-BAR INSULATOR.

cast-iron cap. This turns freely on the pivot, so that if the bus-bar is not wide enough to fill up the entire space between the threaded posts at the end of the strip, the whole strip can be turned so that the posts will come in contact on either side as shown, and then the strip across the top of the bus-bar is held securely against the bus-bar by screwing down the nuts on the posts. This makes it impossible for the bus-bar to get out of position or to tip over. Hence the device is available for holding a bus-bar of any width securely in position.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The past week has been marked by well-sustained activity in all lines of trade, the only section that has not kept step being the extreme South, from which region have come reports of devastating storms and destructive tidal waves. This damage, however, has been of limited effect and to the outer world the chief indication and, in fact, an offsetting gain has been to mark up the price of cotton. In general, all branches of industry are feeling the encouraging effect of cooler weather, and the country is apparently settling down to a very busy winter. From Pittsburg the report comes that the steel mills and furnaces were starting out on October 1 to make record runs. The month has always been regarded as an ideal one in which to make large outputs, and it is believed that this time the records in nearly all lines of production will be broken. The continued demand for material is, of course, an explanation of the rush and a sufficient justification of the enormous output. There has meantime been a marked advance in the price of Bessemer malleable iron, one sale being noted at $20 per ton, which marks a new quotation on the present scale of rising prices. Standard Bessemer pig iron is held at $19 to $19.50. The demands for material from newer industries seem constantly to burden the productive requirements. For example, the Pennsylvania Railroad has started in by ordering 12,500 steel cars, and this is but preliminary to other large orders of the same character. The copper market has continued stiff and strong, and figures around 20 cents are the order of the day, in spite of the fact that an increase in the copper production of this year over last year is expected to the extent of 10 per cent. The reports from all business quarters are good, and the electrical field is steadily productive at its highest capacity. The commercial failures for the past nine months, according to the official figures of *Bradstreet's,* were the fewest in number for any similar period since 1883, although one or two financial suspensions, like that of the Real Estate Trust, in Philadelphia, are responsible for a larger total of liabilities, but even then the showing is good as compared with last year. The amount of the liabilities for the nine months was $89,522,183, a small fraction less than in the same period of 1905, and 22 per cent less than for 1904. The failures for September itself were just over $6,000,000,000 and numbered 561. The total number of failures or suspensions in the nine months was 6,763, as compared with 7,431 in 1905. Bank clearings from all over the country continued very large, and there is every evidence that the requirements of business have had no small effect in causing the present high rates for money. Prices for copper on September 26 were, lake, New York, 20 c., as compared with 16.25 c. just a year ago; lead, in St. Louis, 5.85 c., as compared with 4.75, and tin, New York, 4.40 c., as compared with 32.10 c.

AMERICAN FOREIGN TRADE—The statistics of the government show that the foreign commerce of the United States has crossed the three-billion-dollar line. In the twelve months ending with August, the imports were $1,254,399,735, and the exports $1,759,417,898, a total for the twelve months of $3,013,817,633. The total for the fiscal year 1906 exceeded $3,000,000,000 if the trade with the non-contiguous territory were included; but in this case the three-billion-dollar line is passed without including the trade with the non-contiguous territory, which is no longer considered by the Bureau of Statistics as foreign trade. The contrast of this total of more than $3,000,000,000 in a single twelve months with the trade of earlier years is interesting. It was not until 1900 that the foreign commerce of the United States passed the two-billion-dollar line, having thus increased 50 per cent. since 1899. It was not until 1880 that it first crossed the one-and-one-half-billion-dollar line, having thus doubled since 1879. It was not until 1872 that the foreign trade reached $1,000,000,000, having thus trebled since 1871. It was not until 1856 that the total crossed the five-hundred-million-dollar line, and only in 1835 that it first reached $250,000,000. The growth in the foreign trade, which has given to the month just ended the highest import and export record ever made for August, is distributed through a large class of articles. Meat and dairy products exported in August, 1906, amounted to $16,768,067, against $14,212,278 in August of last year, and $11,219,518 in August, 1904, and $12,688,503 in August, 1903. These are the preliminary figures of the Bureau of Statistics, and do not include those of some of the smaller ports, which when added will slightly swell the total for 1906. August is usually a light month in exports as well as imports. For August, 1906, the total of exports was $129,454,760, against $118,000,000 in August, 1905; $108,000,000 in August, 1901; $104,000,000 in August, 1900, and $105,000,000 in August, 1899, prior to which year the August exports had never touched the $100,000,000 line. It was only in the month of October, 1891, that the $100,000,000 line was crossed as the expert record for any single month; but there have been but nine occasions since the beginning of the year 1900 in which the exports have not exceeded $100,000,000, and in December, 1905, they almost touched the $200,000,000 line, being in that record month $199,738,520.

MEXICAN LIGHT & POWER.—An interim report has been presented by the directors of the Mexican Light & Power Company Limited. It points out that the original plans of the company merely provided for the sale of electric energy at wholesale rates or power purposes in Mexico City and its immediate vicinity. But owing to various circumstances the basis of the company has been considerably enlarged, and it purchased one of three competing firms in the city of Mexico. Beyond that the remaining two competitors have also been acquired by means of a subsidiary concern which has purchased all the properties of these two companies and the whole of the capital stock in which is owned by the Mexican Light & Power Company, Limited. The company claims that it has laid broad foundations for one of the largest hydro-electric installations in the world. In doing so it has absorbed the proceeds of $13,000,000 of the capital stock of the company and all its authorized bond issue of $12,000,000. "Some of the largest expenditures already made were not provided for in the first estimates because the magnitude of the available market for electric power was not then realized." It is pointed out that there will be required to complete the work now in hand the sum of $1,000,000 in excess of the anticipated net earnings for the period ended December 31, 1907. The net earnings for the installation are estimated to reach $190,000 gold per month of January, 1908, "and should the demand for power continue to increase, your directors must consider the advisability of constructing a second hydraulic installation, with the capacity of about 40,000 hp, which, by reason of the preliminary work already accomplished, should not cost more than $2,500,000 gold, and which, after providing for the fixed charges upon this capital expenditure, should ultimately ensure an increase of net earnings to more than $300,000 gold per month." It is thus evident that further working capital will be required. The gross earnings of the company during the first six months of the present year, in Mexican currency, were $1,754,838. The estimated gross earnings for the whole of the current year are $4,000,000, or, deducting operating expenses, the net earnings are estimated at $2,572,000 Mexican, or $1,286,000 gold; while for 1907 it is estimated that the net earnings will reach $1,750,000 gold. This would indicate a profitable enterprise.

HEAVY CROCKER-WHEELER ORDERS.—The following list of recent sales by the Crocker-Wheeler Co., of Ampere, N. J., shows that the company's customers are not confined to any one industrial line. In this short list are represented many of the largest manufacturers in the United States. The majority of the machines are to be installed in plants where Crocker-Wheeler apparatus has already been tested by actual operation. The following are the orders and ratings for the apparatus: Gilbert Knitting Co., one 300-kw A. C. generator, 240 volts, 257 r.p.m., and one 13-kw D. C. generator, 125 volts, 900 r.p.m., as exciter. Eastman Kodak Company, Rochester, N. Y., one 300-kw D. C. generator, 125 volts, 100 r.p.m., driven by Allis-Chalmers engine, to be installed in their power house at Eastman Park. Chicago, Indiana & Southern Railway Company, two 100-kw A. C. generators, 240 volts, 257 r.p.m., and two 6½-kw D. C. generator, 125 volts, 1150 r.p.m., as exciters. American Smelting & Refining Company, Pueblo Plant, Pueblo, Colo., one 20-hp D. C. motor, 500 volts, 820 r.p.m., one 45-hp D. C. motor, 500 volts, 1,000 r.p.m. Arkansas Valley Plant, Leadville, Colo., one 45-hp D. C. motor, 225 volts, 925 r.p.m. Eilers Plant, Pueblo, Colo., one 45-hp D. C. motor, 230 volts, 925 r.p.m. Globe Plant, Denver, Colo., two 20-hp D. C. motors, 500 volts, 820 r.p.m., and one 45-hp D. C. motor, 500 volts, 1,000 r.p.m. Orford Copper Company, Bayonne, N. J., four 300-kw D. C. generator, 125 volts, 150 r.p.m., driven by Mesta engine. Strouse

Adler & Co., New Haven, Conn., one 160-kw D. C. generator, 250 volts, and seventeen D. C. motors, ranging from 1 to 5 hp, all of 230 volts. Becker Bros., Chicago, Ill., one hundred 1¼-hp, Form L motors, for driving bottle-washing machinery. Manufacturers' Contracting Company, Wilmington, Del., one 100-kw D. C. generator, 125 volts, and one 75-kw D. C. generator, 125 volts, to furnish power for lighting the DuPont Building, Wilmington, Del. Borough of Keitztown, Keitztown, Pa., one 75-kw A. C. generator, 2,300 volts, 900 r.p.m., driven by Hornsby Ackroyd oil engine.

ALLIS-CHALMERS-BULLOCK IN CANADA.—Among recent sales by the electrical department of Allis-Chalmers-Bullock, Ltd., Montreal, are a 260-kw engine type, alternating current generator with exciter, switchboard, etc., to the Western General Electric Company, Red Deer, Alta.; 300-kw engine type, alternating current generator, with exciter and other accessories, to the corporation of Barrie, Ont.; 300-kw engine type, alternating current generator and 25-kw exciter to the Belleville Portland Cement Company; 125-kw engine type, alternating current generator, exciter, etc., to the city of Greenwood, B. C., water works; 62½-kw engine type, alternating current generator, switchboard, etc., to C. P. Walker, Winnipeg; 125-kw engine type, alternating current generator, five 10-hp, three 15-hp and one 20-hp induction motor to P. Burns & Co., Calgary, Alta. Fifty-one induction motors ranging from 20-hp down to 1-hp were supplied by Allis-Chalmers-Bullock, Ltd., to the Northern Electric & Manufacturing Company, Limited, to operate the various machines and tools of their new factory in Montreal. The St. Francis Hydraulic Company has found the demand for power so great that it has been obliged to double its plant at D'Israeli, Que. It has bought a 750-kw waterwheel type generator, a duplicate of the machine already there, three 250-kw transformers, switchboard and other accessories. The town of Cardston, Alta., has purchased an electric and water works plant, including generator, switchboard, transformers, lights, and a special compound duplex pump. The Dominion Coal Company, Sydney, N. S., has contracted with the Allis-Chalmers-Bullock, Ltd., for a hoisting engine to operate two water buckets, each capable of holding 800 Imperial gallons to a depth of 345 feet. The hoist will be driven by one of their 300-hp induction motors. The contract also includes three 125-kw transformers.

RECOVERING LOST METAL.—The following from the San Francisco *Chronicle* is of unique interest: "After several fruitless endeavors, the Selby Smelting Company have at last succeeded in securing a method by which it is hoped to recover the several hundred tons of metal that melted and sank to the basement of the Selby shot tower during the fire. The Dwyer-Frickey Electrical Company has been engaged during the last month or so in recovering the ores through an electrical process. After removing several tons of bricks, channels were cut through the bed of metal by forcing electrical heat of great power on its surface. After these channels are all cut through it will be a simple matter for the workmen to throw up the blocks of metal in blocks of nearly a ton each in weight. There are still about 200 tons of lead, zinc and tin remaining firmly imbedded in the ruins of the shot tower. To recover this it is expected that the work will take all the winter. This metal bed is from three to four feet thick and covers the entire floor of the ruins. The process used by the Dwyer-Frickey Company to remove this is known as the electrical arc process, and one of its peculiar features is that while the heat and light obtained in this way is intense and blinding, only ten volts of electricity are used on each implement. Men with their heads and faces covered with queer hats with canvas curtains to protect their eyes are now cutting great channels through the bed. Large piles of metals that have been cut away from the solid mass are lying about the ruins and resemble a sort of mining enterprise. Interested spectators hang about the ruins all day and watch the work with many curious looks at the strange looking electrical implements the men use."

CONNALLY-McILHERAN COMPANY.—The Connally-McIlheran Electrical Engineering Company, of Chattanooga, Tenn., has been incorporated with a capital stock of $10,000. This company comes into the field with a strong force of practical electrical engineers and proposes to do consulting and constructing engineering, sell electrical machinery and supplies of all kinds and do all kinds of repair work. It will give special attention to industrial plans and years of practical experience in this class of work especially fits them for it. The engineers identified with this company consist of the following: W. B. Connally, formerly electrical engineer of the Wellman-Seaver-Morgan Engineering Company, of Cleveland, O.; W. C. McIlheran, formerly electrical engineer for the Decatur Car Wheel & Manufacturing Company, of Birmingham, Ala., also recently with the Tennessee Coal, Iron & Railroad Company; W. C. McAfee, electrical engineer for the Atlanta Steel Hoop Company, of Atlanta, Ga.; H. A. Clark, electrical engineer for the United States Cast Iron Pipe & Foundry Company, of Chattanooga, Tenn., also formerly electrical expert for the Gregory Electric Company, of Chicago. The two latter named will not be actively identified with the company for the present. This company expects to extend its operations over the greater portion of the South, giving special attention to the new work arising on account of the power plant being constructed on the Tennessee River, giving Chattanooga cheap power. The offices are in the new Pound Block, corner Eleventh and Market Streets, Chattanooga.

THE H. T. PAISTE COMPANY, of Philadelphia, has increased its business to such an extent that it has had to move into a new factory. The building is 50 x 120 ft.; it has four stories and basement with a floor space of 30,000 sq. ft., which practically doubles the firm's former capacity. The power plant consists of an 80-hp Coatesville boiler, with Cochrane feedwater heater and purifier, and a 60-hp Ball engine direct-connected to a 35-kw Westinghouse direct-current generator. The power is distributed for the different floors by individual motors driving groups of machinery. Automatic machinery is largely used, insuring uniformity of product, and each article is separately inspected before being packed for shipment. The factory is modern in every respect, which tends to enhance the quality of goods made therein. The Paiste line covers more than 400 specialties, including Paiste sockets, Holoshade sockets, taplets, panel cut-outs, panelettes, pushing attachment plugs, all lines of cut-outs, rosettes, receptacles, etc. It is gratifying to find the product of this company receiving recognition to such an extent that it is obliged to double its capacity to take care of its business.

WIRES AND CABLES IN JAPAN.—Data from United States Consul-General Miller, at Yokohama, deal with the mechanical and electrical growth of Japan. Owing to the immense development of electrical enterprises in Japan the demand for copper wires and cables is increasing daily, and the Furukawa Copper Mining Company has decided to establish a new factory for the manufacture of copper wires at Nikko, the present factory being found to be inadequate to meet the demand. According to the latest report the total output of copper wires from their works amounts to 300,000 to 400,000 kin (kin = 1⅓ pounds) per month, which is chiefly supplied to the various cable manufacturing companies of Tokyo and Yokohama. The majority of the covered wires and cables used by the department of communication is imported from abroad and the native manufacturers are said to be contemplating a cable factory on a very extensive scale.

COLUMBUS LIGHTING PLANT.—It is stated from Columbus, Ohio, that the municipal lighting plant has eaten up a large sum of money and has proved a failure. The managers have asked for $140,000 with which to tide over the institution, but the City Council has not had the temerity to ask the people to sanction another bond issue. The investment in the lighting plant within a few years has grown from $63,000 to nearly $500,000. A short time ago, when $100,000 was put into the plant it was promised that the concern would be the finest in the country. Director of Public Service Lied states that if more money is not forthcoming at once the plant will be thrown out of business and $500,000 wasted. He says that the present plant is wholly inadequate. The city is paying private electric light companies $200 per night to light the streets that the municipal plant cannot take care of.

RAILROAD PLANT FOR MEXICO.—The Cananea Yaqui River & Pacific R. R. Co., an extension of the Harriman interests into Mexico, has about completed plans and specifications for its terminals to be located at Empalme, Sonora, Mexico, this point being located a short distance from the port of Guaymas. The terminals will include an up-to-date machine shop, erecting shop and round house. It is proposed to install practically all motor driven machinery, which will consist of from 2 to 4 planers, 8 engine lathes, 1 engine wheel lathe, and other necessary drills, trip hammers, etc. The above company is now in the market for the complete equipment for these shops. The shop will be constructed with a view of handling from 5 to 10 engines per day for light and heavy repairs. Mr. Charles E. Walker, Tucson, Ariz., is purchasing agent for the system.

POWER AT SCHENECTADY.—It is reported from Schenectady that one day last week the General Electric plant consumed 400 tons of coal in supplying sufficient energy to keep the big shops in operation, and it is said that the company has placed an order for a supply of 25,000 tons to be delivered at the earliest possible date. The cause of this consumption of coal is the fact that the plant is under the necessity of manufacturing practically all the energy required to keep the shops in operation. The Hudson River power plant at Spier Falls, upon which the local shops are largely dependent, is unable at the present time to furnish sufficient power on account of the low water conditions. The season has been unusually dry and the volume of water running over the falls is inadequate for the needs of the power supply. The Hudson River plant is also carrying a heavy general load.

GENERAL ELECTRIC FACILITIES.—The General Electric Company, of Harrison, has awarded the general contract for the erection of a three-story reinforced concrete building on the corner of Fifth and Sussex Streets, Harrison, to the American Concrete Steel Company, of Newark. The building will be 250 feet in length by 80 feet deep, and is expected to be completed within fifty working days. The cost of the building will be $28,800. The General Electric Company has purchased the machinery specified in the list sent out in June and which aggregates in value about $125,000. Most of the new machinery is required for equipping the new addition to the company's turbine factory at Schenectady, N. Y., which is about 150 by 800 feet, three stories high.

CLEAR CREEK POWER.—The management of the Clear Creek, Colo., and Gilpin Mining, Drainage & Transportation Tunnel Company will erect a new power house 500 feet below the site of the present mill. Bids have been called for the construction of a pipe line 3,750 feet long to supply power for the turbines and dynamos. This will provide power for drills, transportation and fans for the tunnel. A surplus will be sold to other mines. The company owns ninety-two properties, covering about 500 acres, besides forty-five acres along Clear Creek, valuable for mill site and water power facilities, a reservoir site of 160 acres near Empire, and 1,500 inches of the waters of Clear Creek for a distance of four miles.

NEW YORK TRACTIONS.—The New York State Railroad Commission has granted permission to the Manhattan Railway Company to issue $4,800,000 new stock for construction and equipment. Some of the money to be received from the sale of the stock has already been expended. The commission has granted permission to the New York & Queens County Railway Company to issue a mortgage for $10,000,000. Under the order of the commission only $8,000,000 can be issued by the road at this time. All but $2,000,000, which is for the refunding of existing mortgages, is for new power houses and equipment and the reconstruction of a portion of the road.

POLICE SIGNALS FOR WHEELING.—The Wheeling, W. Va., council committee on police has recommended the council to enter into a contract with the National Telephone Company for the installation of a telephone police system for a term of five years at an annual rental of $800. By the terms of the contract the company is to place at points designated by the police committee 40 boxes containing telephones and signal lamps attached and five additional lamps. These telephones are to be connected with the central police office by ten trunk lines, to be operated from an independent switchboard.

NEW EQUIPMENT FOR EASTMAN KODAKS.—The Eastman Kodak Company, of Rochester, N. Y., in making needed extensions to the present power equipment, has contracted for a new 22-in. by 42-in. Reynolds Reliance Corliss engine for direct connection to a 300-kw direct-current generator. The new engine, which will be furnished by the Allis-Chalmers Company, of Milwaukee, is to operate at a speed of from 100 to 105 r.p.m. non-condensing and under 125 lbs. steam pressure. The engine fly-wheel will measure 15 ft. in diameter and weigh approximately 30,000 lbs.

PLANT NEAR PHILADELPHIA.—The Philadelphia Suburban Electric Company, with general offices in the Land Title Building, Philadelphia, has begun taking estimates for the large lighting plant that it is to erect near the city line of Philadelphia. This company owns and operates the plants at Morton, Lansdowne and Clifton Heights and practically controls all of the electric lighting in Delaware County. The new plant will have a capacity of about 2,500 to 3,000 kw and will be modern and up-to-date in every particular.

PLANT FOR OURAY, COL.—Mr. E. A. Phinney, secretary and manager of the Ouray Electric Power & Light Company, informs us that it is about to close contracts for an addition to their equipment, of one 200-kw, three-phase, 2,300-volt generator, to be driven by a new water wheel. This will give the plant 500-kw capacity. The new unit will be devoted to the town lighting load, while the present unit of 300-kw will be operated for power purposes only.

SWITCH AND PANEL MANUFACTURE.—The Waterbury Company, of 69 South Street, New York, announces the sale of its switch and panel board business, with its complete equipment, to E. C. Tibbals & Co., with office and factory at Waterbury and Ten Eyck Streets, Brooklyn. Mr. Tibbals, who will give his attention personally to the business, is an experienced electrical engineer, familiar with the requirements of the profession and of contractors.

PLANT FOR MAUCH CHUNK.—The Mauch Chunk Heat, Power & Electric Light Company, of Mauch Chunk, Pa., is a recent purchaser of a 20-in. by 36-in. Reynolds Reliance Corliss engine of the belted type, built by the Allis-Chalmers Company, of Milwaukee. The new unit will operate at a speed of 110 r.p.m. non-condensing under a steam pressure of 120 lbs. The engine is being installed to drive electric generating apparatus.

SOUTHERN PACIFIC ADOPTS WIRELESS.—The Southern Pacific Company closed negotiations with the Atlantic De Forest Wireless Company Saturday for wireless for their ships plying the Atlantic Coast. The first installations will be placed on board their new steamships, *Momus, Antilles* and *Creole.*

COLBY ELECTRIC FURNACE.—It is stated that experiments have been made at the Schenectady works of the General Electric Company with melting brass in the Colby electric induction furnace, which has been introduced for steel working at the Disston works, Philadelphia.

LYNDON, KAN., MUNICIPAL PLANT.—Specification bids have been received for the municipal lighting plant to be installed by the city of Lyndon, Kan. The consulting engineer is Mr. M. Dunsworth, of Emporia, Kan. The city clerk is Mr. J. H. Yearout.

Financial Intelligence.

THE WEEK IN WALL STREET.—In a general way it may be said that the uncertainties of the Cuban situation, the movements in the political field and the tightness of money all caused the liquidation which during the week tended very much to lessen the general strain and bring relief. Although the market was quite active, nearly 7,000,000 shares being dealt in, prices tended to ease off until the close of the week when a return of strength was noted in moderate degree. The circular of Edey, Brown & Sanderson put the matter very well when it said "Conditions on the whole were not calculated to arouse enthusiasm

NEW YORK

	Sept. 25	Oct. 2		Sept. 25	Oct. 2
Allis-Chalmers Co.	16¼	17¼	General Electric	165	166
Allis-Chalmers Co. pfd.	40½	42	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	72¾	73¼	Mackay Cos.	72⅜	72
American Locomotive pfd.	112	111	Mackay Cos pfd.	71	71
American Tel. & Cable	90	90	Marconi Tel.	...	...
American Tel. & Tel.	138	139¼	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit.	76	77⅜	N. Y. & N. J. Tel.	...	...
Electric Boat	15	15	Western Union Tel.	83	...
Electric Boat pfd.	60	60	Westinghouse com	148	145
Electric Vehicle	12	11	Westinghouse pfd	...	...
Electric Vehicle pfd	18	18			

BOSTON

	Sept. 25	Oct. 2		Sept. 25	Oct. 2
American Tel. & Tel.	139	139	Mass. Elec. Ry. pfd	72	70½
Cumberland Telephone	...	118	Mexican Telephone	...	4¼
Edison Elec. Illum.	238	235¼	New England Telephone	129	130
General Electric	...	165½	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	...	19	Western Tel. & Tel. pfd.	87	87

PHILADELPHIA

	Sept. 25	Oct. 2		Sept. 25	Oct. 2
American Railways	51¾	51	Phila. Electric	8¾	8¼
Elec. Co. of America	11⅛	11¼	Phila. Rapid Trans.	29¾	28¾
Elec. Storage Battery	...	70	Phila. Trac on	...	97⅞
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Sept. 25	Oct. 2		Sept. 25	Oct. 2
Chicago City Ry.	160	140	National Carbon	84½	85
Chicago Edison	...	140	National Carbon pfd.	110	115
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co.	...	118½	Union Traction pfd.	...	...
Metropolitan Elev com.	28	28			

with respect to the stock market. In view of what did take place it must be admitted that stocks displayed considerable strength." One of the more notable instances of weakness was Western Union, which closed the week at 86 upon dealings in 2,370 shares, and which a year ago was quoted at 93¼. The coming increase in the capital obligations of the company hardly warrant this and in many quarters it is expected that a recovery in this standard, well-tried security must take place. Another electrical security to which attention has been directed during the week is the American Telephone & Telegraph, which has just declared a quarterly dividend of 2 per cent, placing the stock upon a regular 8 per cent basis. President Fish stated that it was the sentiment of the directors that in view of the earnings of the company and the outlook it was the proper time to put into effect this policy, which is in every way better for the stockholders than a 6 per cent rate of dividend with two semi-annual extras, making 7½ per cent for the year. The increase in the telephone business is tremendous and there seems no good reason why the highest rate cannot be continuously maintained. At the same time it may be pointed out that this stock has been ranging below 140 and closed the week at 138¾. It will now be interesting to see the course of its quotations. During the week General Electric on 1,500 shares ranged between 164½ and 166½, or just 17 points below last year, although it would be difficult to find any explanation for this as the company is doing the largest business in its history or more than $50,000,000 a year. The electric tractions were fairly active, 146,000 shares representing the dealings in Brooklyn Rapid Transit, and closing at 76¾ for the week and advancing this week to 77½. In the open market during the present week the curb stocks have all shown general strength on fairly large trading, and an advance may be noted in the Mackay Companies' securities, for which higher prices are promised and appear to be merited. The condition of the market appears to narrow down to the money situation except so far as disturbance may come from politics. If money should be easy during the next 90 days it seems certain that higher values will be recorded in electrical and industrial properties and in some of the minor trunk railroad stocks. The closing quotations for October 2 are recorded on the preceding page.

BELL TELEPHONE DIVIDEND.—The directors of the American Telephone & Telegraph Company have declared a quarterly dividend of 2 per cent. The dividend is designated as quarterly, placing the stock upon a regular 8 per cent per annum basis, as against 7½ per cent heretofore. Following the declaration of the dividend, President Fish said: "It was the sentiment of the directors that in view of the earnings of the company and the outlook it seemed that this was the proper time to put into effect a policy that had been suggested for a long time, of putting dividends on a basis of 2 per cent quarterly with the expectation of continuing them at that rate."

FREMONT, NEB., LIGHTING BONDS.—The city has just sold $50,000 municipal lighting bonds which brought a premium of $60. Work will now go forward on the improvements.

BULLOCK IN CANADA.—Advices from Montreal state that the Allis-Chalmers-Bullock Company, of Canada, has decided to increase its capital from $1,200,000 to $2,500,000. The new capital will be used in enlarging a number of the present buildings and increasing the equipment.

NEW ORLEANS EARNINGS.—The New Orleans Railway & Light earnings for the month ending August 31 are as follows:

	1906.	1905.		Changes.
August gross	$433,457	$358,375	Inc.	$75,082
Expenses	251,831	215,070	Inc.	36,761
August net	$181,626	$143,305	Inc.	$38,321

Earnings for the eight months ending August 31, 1906:

Gross	$3,776,377
Expenses	2,056,984
Net	$1,719,393

The surplus is over $478,000.

NEW HAMPSHIRE CONSOLIDATION.—A special dispatch from Dover, N. H., of October 2, says: "The property of the Dover Gaslight Company, which includes gasworks and a plant which supplies electric light and power for the cities of Rochester, Somersworth and Dover, and also the town of Salmon Falls, as well as motive power for the Portsmouth, Dover & York Street Railway, has been sold to a New York syndicate. The purchasers are styled the Twin State Electric Light and Power Company, but the personnel of the corporation is not indicated. It is understood that interests representing the Atlantic Shore Line Railroad Company, which operates the Portsmouth, Dover & York Street Railway and other lines, are prominent in it."

NORTH GEORGIA ELECTRIC MORTGAGE.—The North Georgia Electric Company, of Atlanta, has filed a mortgage of $7,500,000 to secure fifty-year five per cent bonds. The Knickerbocker Trust Company is trustee. The company will develop a water power and hydro electric plant.

ELECTRICITY IN MANILA.—The Manila Electric Railroad & Lighting Corporation, at a directors' meeting, declared a dividend of one per cent on the capital stock of the company. This is the second dividend since January 1, 1906. The corporation operates the Manila Street Railway & Lighting system built by J. G. White & Company, of New York, in 1905, at a cost of $5,000,000. The property includes more than fifty miles of track and a power house of 3,000 kw capacity. The rolling stock consists of 100 standard convertible and open American cars.

SALE OF TROLLEY PROPERTIES.—In the annual report of the New York, New Haven & Hartford Railroad, President Mellen says: "Owing to opposition in Massachusetts to the ownership by this company of the securities of certain street railway companies in that State, a sale was made on June 25, 1906, of all of such securities (except those of Worcester & Webster and Webster & Dudley Street Railway Companies, which are also held under lease approved by the properly constituted authorities of the State) to a voluntary association known as the New England Investment & Security Company. Promissory notes were given for the payment of a sum equivalent to the cost of such securities and the association issued its common and preferred shares to a banking house in sufficient amount under contract of sale to pay said notes as the shares are disposed of. Hereafter the interest of the Consolidated Railway Company will be limited to the securing of payment of the notes which were given for the securities sold and to limiting its liability upon its indorsement upon the preferred shares of the association. An option of call at 105 upon said preferred shares was given in consideration of the indorsement of the same, and it is believed that the association will within a reasonable time develop sufficient financial strength to enable such call to be exercised and such indorsement to be cancelled. The securities were acquired in the hope and opinion that the union of the lines in question into one company through the construction of certain connecting links and feeders which were under consideration, would have developed sufficient earning capacity and economy of operation to have made the securities desirable investments. It was useless, however to continue the investments and be the target of attack and misrepresentation that would have been the result, and it was thought better to retire without loss than engage even in successful litigation for a profit that at the best was only prospective."

DIVIDENDS.—The directors of the Union Switch & Signal Company have declared the regular quarterly dividend of 2½ per cent on the preferred stock and 2 per cent on the common, both payable October 15. The directors of the Westinghouse Machine Company have declared the regular quarterly dividend of 2½ per cent, payable October 10. The directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable October 15. The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent on the stock, payable October 1. The Manila Electric Railroad & Lighting Corporation has declared a dividend of 1 per cent, payable October 15. The Pacific States Telephone Company has declared a quarterly dividend of 1¼ per cent to cover the quarter ending September 30, 1906. The action of the directors in resuming dividends was generally expected and the new rate of 5 per cent probably represents a fair return to the stockholders, considering the losses and complications arising out of the San Francisco fire. Up to the time of the disaster the company had been paying 7 per cent. The directors of the Mexican Telephone & Telegraph Company have declared an initial dividend of 2½ per cent on the preferred stock, payable November 1, to stock of record, October 15. There is $200,970 preferred stock outstanding, par $10. The directors of the Cincinnati, Newport & Covington Light & Traction Company have declared the regular quarterly dividend of 1⅛ per cent on the preferred stock, payable October 15. The Bell Telephone Company, of Buffalo, has declared a regular quarterly dividend of 1½ per cent, payable October 1. The directors of the Standard Underground Cable Company have declared a regular quarterly dividend of 3 per cent, payable October 10. The Hall Signal Company has declared a quarterly dividend of 1¾ per cent on the common stock, and a dividend of ¼ of 1 per cent on the preferred, both payable October 1. The preferred has already received 6 per cent in the present corporate year, so that the latter is an "extra."

GENERAL NEWS.

Construction News.

PINE BLUFF, ARK.—The wires of the Southwestern Telegraph & Telephone Company are to be placed underground in this city.

LAKE VILLAGE, ARK.—This city has decided to install a municipal water and light plant. Contracts have not yet been let for the work.

MALVERN, ARK.—The City Council on Sept. 21 granted the Ong Chair Company a 20-year franchise for an electric light plant, the same to be in operation in 90 days.

BONO, ARK.—The farmers in this vicinity have organized a mutual telephone company and have elected W. B. Broom, president. The line will be built at once, and the central office will be at Bono.

LOMPOC, CAL.—The Home Telephone Company has made an application for a franchise in this city. The city attorney has been authorized to prepare an ordinance for the franchise, and the city clerk instructed to advertise for bids.

STOCKTON, CAL.—The Central California Traction Company has placed on record a mortgage to the Safe Deposit & Trust Company, of San Francisco, for $1,500,000. The proceeds will be used for extending its interurban electric lines from Stockton to Sacramento and from this city to various parts in this county.

OROVILLE, CAL.—E. J. Mitchell, city clerk, writes that Engineer L. J. Hohl, 1834 Delaware Street, Berkeley, has been here looking over the city and will work out a plan and submit a detail report in about 30 days on the question of municipal water works, electric light plant and gas works. An election will likely be held to vote on issuing bonds for same.

MERIDEN, CONN.—The Consolidated Railway Company has commenced the construction of its new electric railway from Middletown to Meriden.

THOMPSONVILLE, CONN.—Parker H. Kemble, of Thompsonville, manager of the Northern Connecticut Company, writes that it is not proposed to construct a gas plant at present; the company will, however, start to build a new power plant. All engineering work will be under the immediate direction of the general manager.

BRIDGEPORT, CONN.—Owing to the trouble the Connecticut Railway & Lighting Company has had with its Bulls Bridge power plant, announcement is now made of the company's intention to build a similar plant about ten miles farther down the Housatonic River. The proposed plant will cost in the neighborhood of $700,000. Arrangements are being made for the erection of a steam plant in the western part of Waterbury.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 9, to furnish at the navy yards, etc., Portsmouth, N. H., Boston, Mass., Newport, R. I., New London, Conn., New York, N. Y., League Island, Pa., Annapolis, Md., Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 172—Motors, etc. Application for proposals should refer to schedule 172. H. T. B. Harris, Paymaster-General, U. S. A.

WASHINGTON, D. C.—Bids will be received until Oct. 30 by the Bureau of Supplies & Accounts, Navy Department, Washington, D. C., for furnishing at the Navy Yards, Mare Island, Cal., and Puget Sound, Wash., and the naval training station, San Francisco, Cal., a quantity of naval supplies as follows: Schedule 188—telephones, etc. Schedule 189—electrical supplies, etc. Schedule 190—incandescent lamps, electrical supplies, etc. Schedule 191—motor hoists, pipe bender, steel beams, etc. Schedule 192—pumps, bar steel, asbestos packing, steam packing, copper pipe, friction board, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

ATLANTA, GA.—Capitalists from this city have made a proposition to the authorities at Americus, looking to the establishment of a power, gas and electric plants in that city, and also the building of a street railway.

BRUNSWICK, GA.—The Bell Telephone Company is ready to commence work on its conduit system for the installation of the improved central emergency telephone system in this place.

NAMPA, IDA.—The City Council has granted a franchise to W. E. Pierce, of Boise, and associates, to build an electric railway on certain streets of the city.

MASON CITY, ILL.—Work is progressing rapidly on the foundation for the municipal lighting plant. The plant will cost more than $10,000.

PANA, ILL.—A franchise has been granted by the City Council to the Springfield-Southeastern Traction Company for the construction of an electric railway over Dewitt and Chestnut Streets. This is the first franchise granted along the route of the Springfield road, which will be constructed within the next year. Pana will be the central point, and the power house and the car shops will be located here.

NEW CASTLE, IND.—The Indianapolis, New Castle & Toledo Traction Company has commenced work on the construction of its new power house.

COVINGTON, IND.—Charles A. Brown, of Covington, has secured the contract for rebuilding the water works and electric light plant which was recently burned.

GOSHEN, IND.—The Plymouth, Goshen & White Pigeon Railway has been organized to connect the cities named and the intermediate towns. The new line will be 48 miles long.

WABASH, IND.—V. J. Drayer, president of the Indiana Central Traction Company announces that the road has been financed and that the construction of the line from Wabash to Warsaw will commence at once.

INDIANAPOLIS, IND.—It is reported that Independent telephone managers representing exchanges having 20,000 patrons have contracted with the Automatic Telephone Company, of Chicago, to build a new toll line from Indianapolis to Chicago.

COLUMBUS, IND.—The Grammer Telephone Company has purchased the exchange building and equipment of the Burnsville Telephone Company, and the exchange of the last named company will be moved to Grammer. The Burnsville people are now trying to make arrangements with the Citizens' Telephone Company, of this city, to establish a branch exchange there.

SOUTH McALESTER, I. T.—The Pioneer Telephone & Telegraph Company has filed notice of its increase in capital stock from $3,000,000 to $10,000,000.

SAPULPA, I. T.—J. A. Boyd, of Sapulpa, secretary and treasurer of the new electric light company, writes that the proposed new electric light plant will cost $20,000. E. C. Reynolds, of Tulsa, is president.

ACKLEY, IA.—A. T. Whittle and others will install a local telephone exchange.

WAPELLO, IA.—The Wapello Electric Light & Power Company is about to ask bids for constructing a water and light plant, estimated to cost $15,000.

ESSEX, IA.—An election will be held on Oct. 2, for the citizens to vote on the question of granting a franchise to Oscar Nelson for operating an electric light and power plant.

CHAPMAN, KAN.—The City Council has granted a 15-year franchise to Arthur Williamson to install electric lamps.

OBERLIN, KAN.—This city is installing a city electric light system in connection with the city water works, which will cost $10,000.

GOODLAND, KAN.—The Goodland Light & Power Company has accepted a contract with the city to do the pumping for the city's utilities.

LEAVENWORTH, KAN.—Special inducements have been offered the interurban company by business men and citizens of this city to rebuild its power house in the city.

MT. STERLING, KY.—The East Kentucky Telephone Company of this city, with lines all over this section of Kentucky, has been sold to the People's Independent Ice & Coal Company, of St. Louis, Mo. The new owners will rebuild and reorganize the plant.

JONESVILLE, LA.—The Council is contemplating the establishment of a light plant.

HAMMOND, LA.—The Cumberland Telephone Company is remodeling its entire system here and making improvements which will greatly improve the service when completed.

NAPOLEONVILLE, LA.—Bids will be received until Oct. 20 by Philip H. Gilbert, Mayor, for constructing an electric light plant. H. B. Barringer, of Cinclare, La., is consulting engineer.

AUGUSTA, ME.—The work of installing the new generator at the Kennebec Light & Heat Company's power station is making good progress. One of the new generators is already in working order and the others will be ready in the near future.

HYATTSVILLE, MD.—At a meeting of the Mayor and Town Council, held Sept. 25, the Mayor signed a contract with the Potomac Electric Power Company, of Washington, D. C., to furnish electricity for ten years for lighting the streets of Hyattsville. The company is to furnish not less than 100 incandescent lamps of 30 cp each at $12 each per year, and as many arc lamps as may be ordered by the town at $65 each per year. The company has applied for a franchise, subject to approval by the voters of Hyattsville, to supply electricity for private and commercial lighting for a period of ten years at the rate of 10 cents per kw-hour. An ordinance embodying the franchise was passed and will be submitted to the voters at a special election to be held on Oct. 10.

CHESTERTOWN, MD.—The Kent Traction Company, of Kent County, at Chestertown, has been incorporated to build an electric railway to connect Chestertown, Tolchester, Rock Hall, Sandy Bottom, Georgetown and Fairlee by an electric railway. The line will cost approximately $300,000, and it is expected that work will commence on the road within 30 days. The contract for the construction of the line between Tolchester and Chestertown has been awarded to D. E. Baxter & Company, of New York, N. Y. A. Lamkin, of Baltimore, is interested in the project.

TAUNTON, MASS.—Work has commenced on the extension of the municipal lighting system to East Taunton.

TURNERS FALLS, MASS.—The Franklin Electric Light Company will install 350 electric lamps in the shops of the Montague City Rod Company immediately.

ELMWOOD, MASS.—Poles are being erected for the new electric lamps, and it is expected that several of the private residences will be lighted by electricity as well as the public buildings.

GARDNER, MASS.—The Gardner Electric Light Company has recently placed an order with the Stanley-G. I. Electric Company, of Pittsfield, for a new alternating-current generator of 210-kw capacity. This machine is a duplicate of the generator purchased last December, and will take the place of two of its older machines.

BROCKTON, MASS.—The Edison Electric Illuminating Company has petitioned the city for the privilege of placing 8,900 feet of underground conduits in the center of the city. A petition has also been received from the Brockton Peat, Fuel & Heating Company, asking for right to maintain poles and wires in the street and ways of the city for the transmission of electricity for power and heat.

SOUTH HADLEY FALLS, MASS.—The Selectmen have granted a franchise to the South Hadley Falls Electric Light Company to erect poles and furnish electricity for light and power from the Falls to the Center. The decision of the board means that the Falls will have a 24-hour service. The company will commence work in a few days and expects to have its line completed by Nov. 15.

ABINGTON, MASS.—The Edison Electric Illuminating Company, which now owns the plant in Brockton, Whitman, Abington, North Abington and Rockland, is to apply for the privilege of having the wires connected, so that in case of a breakdown at either the Brockton or North Abington stations, electricity could be supplied from the other station. The company is also planning to use electricity from the Abington plant in connection with the Brockton plant, as there is a large surplus of energy at the local plant.

PITTSFIELD, MASS.—At a special meeting of the stockholders of the Pittsfield Electric Company, held Sept. 24, it was voted to increase the bond issue from $100,000 to $150,000, the proceeds to be used for taking up the bonds of the company now outstanding and for paying a portion of the company's floating debt incurred for construction. It was also voted to increase the capital stock of the company from $150,000 to $225,000 for the purpose of paying a portion of the floating debt and to provide funds for installing underground wires as have been required by legislation.

ELK RAPIDS, MICH.—Wm. E. Donkey, of Big Rapids, has secured a franchise to establish an electric light plant.

SAULT STE. MARIE, MICH.—The Trans-St. Marys Traction Company is preparing to extend its line to Algonquin, a suburb of Salt Ste. Marie.

MARQUETTE, MICH.—The stockholders of the Marquette County Telephone Company have voted to increase the capital stock from $60,000 to $100,000.

GRAND RAPIDS, MICH.—The Grand Rapids & Battle Creek Inland Lakes Railway Company has secured practically all the right of way for its line from Kalamazoo to Gull Lake, and it is expected that work will commence on the line this fall.

ESCANABA, MICH.—Owing to the blowing out of the cylinder heads of two engines at the plant of the Escanaba Street Railway Company on Sept. 18, all street car traffic was stopped and concerns throughout the city receiving electricity from the street railway plant were compelled to suspend operations.

CORRUNNA, MICH.—The Michigan Railway & Light Company has made an application to the Commission of Railroads for the approval of the proposed crossings of its line with the Ann Arbor Railroad at Corunna, and the Cincinnati, Saginaw & Mackinac Railroad at Durand. This company was organized for the purpose of building an electric railway from Corunna to Durand and taking over the property of the Owosso & Corrunna Traction Company, which now owns and operates a road between Owosso and Corunna. It is stated that the right of way and franchises have all been secured, and that the company intends to begin work on the line within a short time.

BRAINARD, MINN.—The Brainard Hydro-Electric Power Company has made a proposition to furnish the city with electricity.

ST. PAUL, MINN.—At a recent meeting of the City Council a resolution was passed directing the board of public works to prepare the specifications for street lighting for 1907 and present them at the next meeting. Its purpose is to enable the Council to award the lighting contracts immediately after the budget for 1907 is passed.

BRANDON, MISS.—Kirkpatrick & Johnson, of Jackson, are making preliminary plans for water works and electric light plant, to cost about $25,000. R. E. Gayden is mayor.

CLARKSDALE, MISS.—Work has commenced on the rebuilding of the municipal electric lighting system. The city is being rewired and other improvements are being made.

NATCHEZ, MISS.—The franchise of the Cumberland Telephone Company, which was nullified several weeks ago, was reinstated by the Board of Aldermen and Mayor on Sept. 20. The company will install the flashlight system and make other improvements to its entire plant.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company has been financed and $500,000 in bonds have been issued for the construction of 22 miles of electric railway between Corinth, Miss., and the National Shiloh Park, Tenn. The company will supply electricity for operating the road and for lighting and power for Corinth and to towns along the route. By a special act of Congress the company has secured the right to run its cars directly into Shiloh Park and erect a modern ten-story hotel on the grounds. A. Rubel is president, and Mark Bynum, treasurer of the company.

ROLLA, MO.—The citizens voted Sept. 28 to issue $49,000 in bonds for water works and a sewerage system, also for improving electric light plant by substituting gas engines for present steam plant.

SHELBINA, MO.—Surveyors are at work on the proposed electric railway from Shelbina to Shelbyville, a distance of eight miles. It is expected that work will be started on the grading of the bed for the railway in about two weeks.

SPRINGFIELD, MO.—Work has commenced on the new telephone system to be installed in this city by the Home Telephone Company. The company contemplate an expenditure of $300,000 on its plant in this city.

ST. LOUIS, MO.—The King Electric Company, which furnishes light for Ferguson, De Hodiamont, Wellston, Clayton, Normandy, University City and other places in the county, was sold last week by John C. King to the General Service & Developing Company, of St. Louis County. A. C. Einstein, president of the General Service & Development Company, states that it is the intention to merge the two companies under the probable name of the County Service Company, which will in future supply electricity for light and power for the county. The purchase was made by A. C. Einstein and Paul D. Cable, of Webster Groves, representing the General Service & Developing Company, for $100,000. The equipment of the plant consist of two generators having a capacity of 700 kw, two Babcock & Wilcox boilers of 250 hp, two shell boilers of 100 hp each and one Keewanee boiler of 100 hp.

FREMONT, NEB.—The city has sold $50,000 of municipal lighting bonds which brought a premium of $60. Work will now go forward with the improvements.

AUBURN, NEB.—The Auburn Electric Light Company has recently made important improvements to its plant. It now has over 18 miles of pole line with over 8,000 lamps. The town of Brock is negotiating with the Auburn Electric Light Company to furnish electricity for lighting the town.

EAST ORANGE, N. J.—Henry Floyd has been selected to estimate the cost of a joint municipal lighting and incinerating plant.

ORANGE, N. J.—Press reports state that bids will be viewed on Oct. 25 by the Common Council for the construction of a municipal electric light plant.

ROCKAWAY, N. J.—The Mayor and Common Council have decided to open negotiations with the directors of the local electric light company for the purchase of its plant and to convert it into a municipal electric light system.

TRENTON, N. J.—Benjamin L. Lawrence has commenced suit in the Court of Chancery against the Manalapan Light Company, claiming that the company is insolvent and asking for the appointment of a receiver. Mr. Lawrence is a stockholder of the company, which has electric plants at Englishtown and Freehold.

GOUVERNEUR, N. Y.—The Hannawa Power Company has applied for a franchise to supply electricity for light and power to Gouverneur and vicinity.

NEW YORK, N. Y.—The Electric Power & Equipment Company has been awarded the contract for installing the electric equipment in School 90, Manhattan Borough, for $14,930.

CANASTOTA, N. Y.—Bids will be received until Nov. 1 by E. B. Roberts, village clerk, for lighting the streets and public squares of this village for a period of two or five years, beginning February 6, 1907.

NEW YORK, N. Y.—Bids will be received until Oct. 8 by C. B. J. Snyder, Superintendent School Buildings, New York City, for installing electric equipment in addition to and alterations in School 172, Borough of Manhattan; also in addition to and alterations in School 66, Brooklyn Hills, Borough of Queens.

ORISKANY, N. Y.—G. A. Baer, of Oriskany, writes that it is not proposed to construct a municipal electric light plant, but it is proposed to light the village by electricity. It is reported that the town board of Whitesboro has granted the Hudson River Electric Power Company, of Mechanicsville, a franchise for same.

UTICA, N. Y.—Bids will be received by T. E. McGar, secretary of the State Commission of Lunacy at Albany, N. Y., until Oct. 24, for constructing, heating, plumbing and electric light wiring and fixtures and feeder cables for an acute hospital building; also for construction of conduit through boiler house and an outside lighting system at the Utica State Hospital.

LONG ISLAND CITY, N. Y.—The New York & Queens County Railway Company has been granted permission to issue a mortgage for $10,000,000. Only $8,000,000 can be issued at this time under the order from the State commission. Of this amount $2,000,000 is for refunding of existing mortgages, and the remainder is for new power houses and equipment and the reconstruction of the road.

CHENANGO FORKS, N. Y.—Peters Brothers, owners of a valuable power site and at present conducting a large flouring mill, planing mill and saw mill are to build a concrete dam and power house on the Chenango River for the development of electric energy. The dam will be about 400 feet long, and the power house about 50 x 70 feet, which will be equipped with electrical machinery and traveling cranes, etc. The wheel pits will contain five improved Trump vertical turbines. Surveys have been made for a system of large compensating reservoirs, situated on tribu-

taries of the Chenango River, from which water can be diverted in times of drouth. The designs have been furnished and plans perfected by W. G. Stone, civil engineer, of this city, who will have charge of the construction. Work on the construction will not commence until spring. The work will be advertised and contract awarded this fall, so that contractors can get their material on the ground preparatory for work in the spring.

GRAND FORKS, N. D.—The Grand Forks Gas & Electric Company is constructing a new power house at a cost of $28,000.

FARGO, N. D.—Edward Healy, of Red Lake Falls, has secured the contract for putting in the proposed new power plant, which is to transmit electricity from Red Lake to Grand Forks.

GREENSPRING, OHIO.—The Greenspring Telephone & Electric Company has increased its capital stock from $35,000 to $40,000.

MINERVA, OHIO.—Austin H. Freed, city clerk, writes that it is proposed to construct an electric light plant. Mr. Fry, of Minerva, is engineer.

LIMA, OHIO.—It is stated that the Schoepf syndicate contemplates changing the Columbus & Lake Michigan Railroad, the steam road which it acquired some time ago, to electricity.

CLEVELAND, OHIO.—Bids will be received until Oct. 12 by the Board of Public Service, J. B. Vining, secretary, for steam fittings and connections for municipal electric light plant.

ELYRIA, OHIO.—The City Council has granted a franchise to the Elyria Milling & Power Company to use the streets and alleys of the city for the transmission of electricity for lighting and power in Greater Elyria.

BELLEVILLE, OHIO.—The Bellevue Telephone Company will make extensive improvements to its system in this city. The company will place its wires in underground conduits in the business section of the city at once.

STEUBENVILLE, OHIO.—The National Telephone Company is building a submarine cable under the Ohio River from this place to Benwood. They will carry long-distance wires to Wheeling and other points and will replace the cables of the Belmont Telephone Company.

CANTON, OHIO.—Sealed bids will be received by the Board of Public Service until Oct. 15, for both heating by steam and lighting by electricity or gas, the city hall, old market house, police station, central engine house and the auditorium buildings. B. F. Faust is clerk.

CLEVELAND, OHIO.—It is announced that the Eastern Ohio Traction Company will make improvements to its property in the near future, which will cost $75,000. The rolling stock is to be improved, and important track improvements are to be made to the Middlefield branch.

WESTERVILLE, OHIO.—The citizens have voted to issue $12,000 in bonds for a municipal lighting plant and the purchase of the plant of the Westerville Electric Company. The plant will, it is said, be run in connection with the water works system, and will be enlarged and improved.

BARBERTOWN, OHIO.—The Northern Ohio Traction & Light Company has secured a franchise to string a high-voltage transmission line through the town. The line is to be used to supply electricity for the new Wadsworth extension of the system, which will be put in operation in a short time.

CLEVELAND, OHIO.—The Board of Public Service has selected J. Milton Dyer, Architect, Cuyahoga Building, Cleveland, to prepare plans for a light, heat and power plant to be erected on East Ninth Street, to cost about $500,000. The plant will pump water into the new high-pressure pipes, and light the group plan buildings, furnish power for electric elevators and light downtown streets. It is stated that in addition a steam heating system will be run from the power house.

CLEVELAND, OHIO.—At a recent meeting of the directors of the Cleveland & Southwestern Traction Company a committee was appointed to go over the plans for improvements to the system, and to decide whether to carry out all of the plans immediately and spend $75,000 or to spend only $50,000 for the present. The company is now securing estimates on the cost of installing an additional turbine and boilers in its Elyria power station, to take care of the needs of the Cleveland, Ashland & Mansfield extension to the system, which is now well under way.

TOLEDO, OHIO.—The Toledo Railways & Light Company was the lowest bidder for lighting the streets of the city for periods of either five years or ten years from January 1, 1907, when its present grants expire. Its proposition was to furnish 2,000-cp enclosed-arc lamps for $47 per year on a ten-year contract, or $52 per year on a five-year contract. This is a reduction of $36 per lamp as compared with the present two years existing contract. The Toledo Gas, Electric & Heating Company bid $59.90 on a ten-year contract and $62 per year on a five-year contract. Bids were also received for lighting with Nernst and incandescent lamps. The Toledo Railway & Light Company was also the lowest bidder for these lamps, offering to supply 60-cp Nernst lamps for $15 per year on a ten-year contract and $17 on a five-year contract. On large incandescent lamps it bid $16 per year on ten-year contract and $18 on a five-year contract. The same company also offered to supply luminous-arc lamps at $45 per year for ten-year contract and $49 for a five-year contract. No bids were offered to furnish the city with electricity should the city decide to purchase poles and equipment and maintain its own system.

LAWTON, OKLA.—The Pioneer Telephone Company, which purchased the holdings of the Topeka & El Reno Telephone Company, is contemplating an expenditure of $30,000 in improvements to the system.

SUMMERVILLE, ORE.—The question of constructing an electric light plant is reported under consideration here.

NORTH BEND, ORE.—A wireless telegraph station will be installed in this city by the Pacific Wireless Telegraph Company at a cost of about $2,000.

HOOD RIVER, ORE.—The citizens of Mosier have submitted a proposition to the Hood River Electric Light & Power Company to extend its lines to that place, a distance of between five and six miles. It is also proposed to furnish electricity for the box factory at Mosier.

JENKINTOWN, PA.—The Household Electric Light Company, which has been awarded a five-year contract to light the borough streets, is in the market for the best make of lamps. The company is now making a test of the magnetite lamp.

HOLLIDAYSBURG, PA.—The Juniata Valley Electric Street Railway Company has placed the contract for the grading and construction of its electric line through Huntington. It is the intention of the company to extend the line next year to Mt. Vernon, 12 miles east of this place.

GREENVILLE, PA.—The plant of the People's Electric Light, Heat & Power Company, including buildings and equipment, will be sold by the trustees on Nov. 8. Financial difficulties of long standing forced the company to make an assignment several weeks ago.

PHILADELPHIA, PA.—The Bell Telephone Company has purchased a site at the corner of Broad and Spruce streets, and will erect a new building, the estimated cost of which, including the switchboard equipment, will be $1,500,000. It will contain the executive offices and a central office and have a capacity of 36,000 telephones. The company expects to complete early next year a new central office located at 1705 Broad street, and is also building a new central office at Sixty-fourth street and Woodland avenue, at a cost of $250,000.

WILKESBARRE, PA.—The large hydro-electric plant, which Col. R. Bruce Ricketts has been at work on for the last three years in North Mountain for the purpose of supplying this city, Plymouth, Shickshinny and Berwick with electricity, is beginning to make a showing. The plans of Col. Ricketts are to flood the plateau on North Mountain, which is 12 miles wide, and dam up Lake Ganoga. He has also placed a large dam across Kitchen's Creek, near the old Fodson mill; one across Sickler's Creek and another near the Susquehanna-Tioga turnpike, to prevent the water from Kitchen's Creek going down the lower side of the mountain. The generating plant is to be located on Kitchen's Creek about a mile from what is known as the "Iron Bridge," near Red Rock. Thousands of dollars have already been spent on the undertaking.

ALTOONA, PA.—To provide for the increasing demand for electricity for the operation of the machinery and the production of light in the Pennsylvania Railroad shops and yards here, the various power plants are to be enlarged. At East Altoona the foundation for an addition has already been started, and additional machinery will be installed to treble the capacity of the plant, which furnishes electricity for power and light to the roundhouse and shops, and light to the lower yard. The plant at South Altoona is to be increased by the addition of an 800-hp motor, which will be attached to a 500-kw generator and connected with the Fourth street power plant. At the latter plant a 700-hp engine and a generator of 500-kw capacity will be added. The Fourth street plant furnishes electricity for power to the car shops, light to the yard and operates the switches in the yard.

WESTERLY, R. I.—One of the five new Diesel engines has been put in commission in the new plant of the Westerly Power Company. The power station and new transmission lines will be completed early in the winter, and electricity will be distributed for light and power in the territory, including Westerly, Pawcatuck, Watch Hill, Stonington, Mystic and Noank. The generators will be driven by five oil engines having a capacity of 250 hp each. When these are in operation, four steam power stations, three in Westerly and one in Mystic, will be discontinued. The electrical equipment consists of five 160-kw alternating-current generators, and three direct-current generators of 160 kw each, the last named to be used for the 6½ miles of railway between Westerly and Watch Hill. The cost of reconstructing the lines in Westerly is $30,000, and the new lines to Watch Hill, Stonington, Mystic and Noank will probably be completed within 30 days. The company is expending about $300,000 in improvements and extensions to its plant. William Clark, of Westerly, is president; William Mauran, of Providence, treasurer, and H. B. Rust, of Providence, general manager.

ROCK HILL, S. C.—Preparations are being made for extensive improvements to the local telephone system. A new and improved switchboard will be installed and much cable work done.

WATAUGA, TENN.—The Wautauga Electric Company has closed a contract for the installation of a new system of street lamps, which will be installed within 60 days.

CUSHING, TEX.—Work will commence on the construction of the new electric light plant at once.

LAPORTE, TEX.—The Board of Aldermen has acted favorably on the proposition to erect water works and electric light plant, the total cost estimated at $18,000.

SHERMAN, TEX.—Bids will be received until Oct. 22 by Jas. Knox Taylor, supervising architect, Washington, D. C., for installing a conduit and electric wiring system for the U. S. Post Office and Court House, Sherman.

SALT LAKE CITY, UTAH.—An application for water rights has been filed by A. M. Hill, A. P. Hanson and L. H. Gray, all of Salt Lake City, for a flow of 110 cubic feet per second, to be diverted from the Blacksmith fork of Bear River, in Cache County. The diverting work will consist of a dam, headgate and pipe line 8,000 feet long and 18 inches in diameter. Two hydro-electric units will be installed.

WISE, VA.—The City Recorder writes that water works improvements are not now being considered, and the electric light plant is owned by a private company.

NORFOLK, VA.—Bids will be received Oct. 13 by Mordecai T. Endicott, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for six water-tube boilers, feed-water heaters, pumps, etc., for the power plant, at the Navy Yard, Norfolk.

ROSALIA, WASH.—Arthur D. Jones, of Spokane, has applied for an electric light franchise at this place. The chief promoter of the scheme is the Spokane & Inland Electric Railway Company.

TACOMA, WASH.—As soon as franchises can be secured the Tacoma Railroad & Power Company and the Puget Sound Electric Company will build an interurban railway connecting Tacoma, Puyallup, Sumner and Orting. The line will be 21 miles long.

VANCOUVER BARRACKS, WASH.—The lowest bid opened on Sept. 24 for furnishing electric fixtures for two double barracks and three double sets of officers' quarters has been submitted by the Western Electric Works, of Portland, Ore., at $2,463, and the same has been recommended for award.

SPOKANE, WASH.—Frank McKean, of Chicago, Ill., has announced that he has secured a contract to install a $2,000,000 power plant for the Spokane Western Power & Traction Company. It is expected to develop 2,000 hp, which can be expanded to 40,000 hp. Mr. McKean is connected with the Hydro-Electric Development Company, of Chicago, Ill.

HILLMAN CITY, WASH.—An electric lighting plant is being installed in the factory of Michael Wright, at Hillman City. As the dynamo will supply more electricity than is needed in the factory, R. J. Boehm has agreed to furnish electricity for lighting the stores on Rainer Ave., if the consent of the County Commissioners can be secured to cross the thoroughfare.

EVERETT, WASH.—The Everett Railway, Light & Power Company is contemplating the construction of a hydro-electric plant at Granite Falls, fourteen miles from Everett. The plant will have a capacity of 4,000 hp and will cost about $350,000. The electrical machinery has been ordered and it is hoped to have the plant in operation within a year. E. P. Burch is consulting engineer, and J. T. McChesney, president and manager.

SPOKANE, WASH.—The Northern Pacific Railway Company announces that it will operate an electric railway over the old Union Pacific grade, between Portland and Tacoma, a distance of 145 miles. The Willamette Valley Company has commenced the construction of a line between Salem and Mehama, Ore., which will be 25 miles in length, while the United Railway Company will build 100 miles of road in and outside of the city of Portland, Ore. The Oregon Water Power Company will extend its line from Lents to Trentsdale and establish a ferry over the Columbia River.

KAUKAUNA, WIS.—The Wisconsin Telephone Company is preparing to rebuild its local exchange and system in this place. Over six miles of cable will be used and 250 new poles. All the old telephones will be replaced and new switchboards will be added.

PORT WASHINGTON, WIS.—J. Thompson & Son, of Beloit, have secured the contract for a 100-hp gas producer and engine for $7,500, and Rumsey Pump Company, of Seneca Falls, the contract for a 500-galloon triple-power pump for $890. W. G. Kirchoffer, of Madison, is engineer.

KENOSHA, WIS.—C. H. Stemm, chairman of the municipal ownership committee of this city, has asked the city attorney to draft an ordinance providing for the submission to the vote of the people at the coming election the question of bonding the city for $40,000 for a municipal lighting plant.

LA CROSSE, WIS.—The La Crosse Water Power Company is progressing rapidly with its plans for the construction of its plant at Mormon Riffles, fifteen miles above Black River Falls. Work is being rushed on the dam and buildings, and contracts for material have been placed. The company expects to transmit electricity a distance of 60 miles to La Crosse, and Winona, a still greater distance. Work has commenced on the important extensions to be made by the La Crosse City Railway Company, which will greatly improve and modernize the street railway service here.

EVANSTON, WYO.—A company is being organized here to construct a telephone line at a cost of $5,000 from Kemmerer to Big Piney.

PINCHER CREEK, ALB.—J. E. Woods, manager of the Municipal Electric Light Company, intends installing a telephone system here.

STRATHCONA, ALB.—The Strathcona Radial Tramway Company has been formed here for the purpose of building electric tramways in and around this town. Address Mayor Sheppard.

EDMONTON, ALTA.—Plans have been prepared by the city engineer for the construction of an electric railway to run from Kinestino to Twenty-first street, on Jasper avenue, and from Jasper to the Canadian Northern depot on First street. The estimated cost of the road is $66,000.

NEW WESTMINSTER, B. C.—The Chilliwac Light & Power Company will at once proceed with the construction of a power line from here to Chilliwac. Address J. Burtt Morgan, manager and secretary.

BEAMSVILLE, ONT.—The Hamilton, Grimsby & Beamsville Electric Railway Company is contemplating the extension of its line from this city to St. Catherine.

WELLAND, ONT.—The Town Council is reported to have granted the Welland Electrical Company a franchise to erect poles and string wires through the town.

KINGSTON, ONT.—The Kingston, Gananoque & Perth Electric Railway has applied to the Legislature for permission to build an extension of its line from Lanark to Arnprior.

OTTAWA, ONT.—The Bell Telephone Company has awarded contracts for the remodeling and extension of its central office in this city, which will involve an expenditure of $25,000. Work will commence at once.

FORT WILLIAM, ONT.—The first electric locomotive to be used on the Canadian Pacific Railroad or even in Canada is soon to be installed in the Canadian Pacific Railroad yards here. As soon as the Kakabeka Falls power plant is in operation the company will use electricity for switching in its yards here.

GRAVENHURST, ONT.—W. H. Cross, town clerk, writes that contracts for the proposed electric light plant have been awarded as follows: Electrical apparatus, to Allis-Chalmers-Bullock Company, of Toronto; water wheels, to Jenckes Machine Company, of Toronto, and steel flume to Canada Foundry Company, of Toronto. Contracts for pole line and receiving station not yet let, and no date yet fixed for receiving bids for same.

CHICHUAHUA, MEX.—The Compania Agricola y de Fuerza Electrica de Rio Conchos has been organized to promote the electric power enterprise on Conchos River, about 28 miles above Santa Rosaloa, in this State. The company proposes to build a dam on the river at the place mentioned to furnish electricity for distribution over a great part of the State.

Company Elections.

GRAND RAPIDS, MICH.—At a meeting of the directors of The Boyne River Power Company, held Sept. 25, the following officers were elected for the following year: E. A. Stowe, president; Amos S. Musselman, vice-president; C. C. Follmer, secretary, and Frederick C. Miller, treasurer.

New Industrial Companies.

THE SAFETY ELECTRIC COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $2,500. The incorporators are Alfred P. Miller and others.

THE MOTOR PRINT COMPANY, of Wilmington, Del., has filed a certificate of incorporation with the Secretary of State. The company has a capital stock of $100,000, and will build motors and motor cars.

THE MORGAN CITY ELECTRIC COMPANY, LTD., of Morgan City, La., has been chartered here to do an electrical supply business. The capital stock is $25,000. The incorporators are B. M. Young, president; H. M. Young, secretary and treasurer.

THE AMERICAN GAS FIXTURE COMPANY, of New York, N. Y., has been incorporated to manufacture gas burners and gas and electrical fixtures. The capital stock is $500,000 and the directors are: James Beach, Harry Getsinger and H. M. Gibbons, of New York City.

THE METROPOLITAN ELECTRIC PROTECTIVE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $39,000, to manufacture burglar alarms. The directors are S. B. Hess, Emil Goldberger and Harry Luxenburg, of New York, N. Y.

THE STANDARD MANUFACTURING COMPANY, of Bridgeport, Conn., makers of electric specialties and supplies, has filed a certificate showing an increase of capital stock from $5,000 to $15,000. The funds derived from the sale of the new shares will be applied to enlargements and to the extension of the company's business.

THE ELECTRIC OPERATING CONSTRUCTION COMPANY, of New York City, has been incorporated with a capital stock of $1,000,000. The directors are: A. D. Bowen, San Francisco, Cal.; Maurice A. Viele, George C. Hutchinson, of New York, N. Y.; R. S. Masson, of Los Angeles, Cal., and W. D. Beardsley, of Nyack, N. Y.

THE AUTOLYTE MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State, with a capital stock of $6,000. The company proposes to manufacture automobile supplies The directors are W H. Schleicher, Flushing, L. I.; T. M. Debevoise, Summit, N. J., and E. S. Paine, Brooklyn, N. Y.

New Incorporations.

MONTGOMERY, ALA.—The Thomasville Manufacturing & Electric Company has been incorporated with a capital stock of $11,000 by W. A. Scott and others.

POINT RICHMOND, CAL.—The Great Western Power Company has filed articles of incorporation with a capital of $25,000,000. W. S. Rheem, a director of the East Shore & Suburban Railroad Company, of Port Richmond, is reported interested.

WINDSOR, COL.—Articles of incorporation have been filed for the Windsor Lighting & Power Company by William J. Barker and others. The capital stock is $10,000.

WALSENBURG, COLO.—Articles of incorporation have been filed for the Walsenburg Light, Power & Ice Company, by D. W. Mathews and others. The company is capitalized at $40,000.

ATLANTA, GA.—A charter has been issued to the Atlanta, Griffin & Macon Electric Railroad Company, to build and operate the interurban trolley line between Atlanta and Macon, Ga. The line will pass through several populous towns. The capital is stated at $100,000. The incorporators are: N. P. Pratt, W. A. Wimbish, Clifford L. Anderson, Edwin P. Ansley, of Atlanta; W. J. Massee, J. T. Moore, Minter Wimberly, W. J. Kincaid, James M. Brawner, Seaton Grantland, of Macon; N. B. Drewery, of Griffin.

WESTFIELD, ILL.—A charter has been granted by the Secretary of State to the Westfield Light & Power Company, with a capital stock of $20,000.

CARTHAGE, IND.—The Beck Light, Heat & Power Company has been incorporated, with a capital of $10,000 to construct and operate water works and a lighting plant in Carthage.

SOUTH BEND, IND.—Articles of incorporation have been filed with the Secretary of State by the Winona & Maxinkuckee Railroad Company with main office in this city. The capital is $10,000, which will be increased shortly. The object of the company is to build and operate an electric railway from Warsaw to Culver by the way of Argus. The directors are: Thomas P. Murdock, Edwin P. Taylor, Samuel L. Perley and Alexander Coquillard.

HIGHLAND, IA.—Articles of incorporation have been filed for the Council Bluffs Telephone Company, with a capital stock of $450. The incorporators are Anthony Johnson, Frank Olson and Arthur Anderson.

HIGHLAND, IA.—The Pompas Pillar Telephone Company has filed articles of incorporation, with a capital stock of $352. The incorporators are Chris. Blabaum, William A. Carr, N. P. Schwingle, H. W. Schwingle, Andrew Draves, Nels Nelson and Joseph Pink.

SOUTH OTSELIC, N. J.—Articles of incorporation have been filed with the Secretary of State for the Otselic Valley Railroad Company to operate an electric or gasoline railroad twelve miles long from South Otselic to Georgetown Station. The company is capitalized at $220,000. The directors are B. F. Gladding, E. C. Stack and M. K. Perkins, of South Otselic.

FULTON, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Oswego County Independent Telephone Company. The company has a capital stock of $100,000. The directors are F. A. Gage, Edward Quirk and J. R. Sullivan.

CORTLAND, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Cortland & Auburn Railroad Company. The company proposes to construct and operate a steam or electric road from Cortland to Auburn, a distance of 40 miles. The capital stock is $400,000. The directors include Charles B. Wheeler, of Brooklyn; N. A. Bundy and Walter L. Webb, of Philadelphia, and Charles G. Adams, of Auburn.

ALBANY, N. Y.—The Mountain Home Telephone Company, of Saranac Lake has filed articles of incorporation with the Secretary of State with a capital stock of $150,000. The company will operate in the counties of Franklin, Clinton, St. Lawrence, Jefferson, Lewis, Hamilton and Essex. The directors are Howard Hendrickson, William O. Hendrickson, Henry M. Keys, Frank E. Griffin, William B. Harris, Henry J. Prince, Jr., and Frank E. Derr, of Albany, all of whom are connected with the independent telephone interests of the state.

HOPEWELL, OHIO.—The Indian Camp Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are W. T. Craig and others.

ASHTABULA, OHIO.—Articles of incorporation have been filed for the Merchants' Lighting Company, with a capital stock of $10,000. The incorporators are H. Milton and others.

HAVERHILL, OHIO.—The Haverhill Telephone Company has been incorporated by W. A. Brush, H. T. Massie, and others. The company will build a local telephone system in Haverhill.

OKARCHE, OKLA.—Articles of incorporation have been filed for the Mt. Pisgah Telephone Company, with a capital stock of $55,000. The incorporators are Fred H. Smith, John H. Otis, Daniel Best and Joseph Voss.

BETHEL, PA.—The Blue Mountain Electric Company has applied for a charter to manufacture and supply heat, light and power by means of electricity to the public in the townships of Bethel, and also to Millersburg, Strausstown and Rehrersburg. Capital $8,000. Stanley B. Seyfert, of Lehigh University, South Bethlehem, Pa., has prepared plans for the plant. The officers of the company are: Harvey B. Stambaugh, of Rehrersburg, president; Jacob W. Seyfert, of Strausstown, secretary, and I. B. Klinger, of Millersburg, treasurer.

Legal.

TELEPHONE TRAFFIC INTERCHANGE.—The Texarkana Telephone Company on September 25 filed suit in the local circuit court against the Southwestern Telegraph and Telephone Company for alleged statutory penalties aggregating $100,000 for failure to comply with the Arkansas law requiring it to permit physical connection with its long-distance wires for the transmission of messages by the plaintiff.

THE HOUSE THAT JACK BUILT.—A peculiar chain of incidents, it is alleged, caused the damage to a house in Baltimore, Md., for which Ephraim Feldman and wife, the owners, have sued the Maryland Telephone Company for $2,000 in the Court of Common Pleas. The declaration states that on July 22 the company was erecting a pole in front of the house. Through the negligence of those engaged in the work, it is alleged, the pole fell, striking and breaking an electric wire, which fell against the house, charging the spouts and pipes in the house with electricity. This caused the water pipes to burst, it is also alleged, the water flowing through the house, damaging the ceilings and floors.

SUIT OVER A DAM.—Judge Alton B. Parker, sitting as referee, has rendered a decision in favor of the Hudson River Water Power Company in the suit brought against it for $615,000 by the National Contracting Company. Mr. Parker's decision not only dismisses the suit but awards damages against the contracting company to the amount of $383,352 to the power company. The suit was instituted several years ago, and was based on a claim that certain changes in the plans for the dam which the Hudson River Water Power Company was having built at Spier Falls was such as to constitute a breach of contract and cause damages to the extent of $615,000. The National Contracting Company had the contract for the construction of the dam and plant which were built for the power company. The power company held that it was within its rights in making the changes in the dam, and it brought a counter suit for $383,352, on account of the additional cost it was put to through the withdrawal of the contracting company from the work. The case has been before the New York Court of Appeals and the Appellate Division.

ELECTRIC LIGHT PLANT NUISANCE.—The Supreme Court of Pennsylvania has affirmed the judgment for the plaintiffs in the suit of Ganster et al. versus the Metropolitan Electric Company, the question at issue being that of vibration caused by the running of the machinery of the station. The points in the decision are as follows: (1) Where an electric light company operates its works so as to create a nuisance resulting in injury to the building of an adjoining owner, it is liable therefor. (2) Where the injury caused by a nuisance destroys the legitimate enjoyment of private property so as to amount to a taking of the same, the person injured can recover, though defendant company possesses the power of eminent domain. (3) A corporation can only injure or destroy property where it possesses the power of eminent domain and exercises it in the manner provided by statute. (4) Where there is a continued nuisance, second action for nuisance may be maintained. (5) In a second action for the continuance of a private nuisance, punitive damages are recoverable; it being the duty of defendant to abate the nuisance after the recovery of a judgment in the first action.

AGAINST ARNOLD MONOPHASE PATENTS.—On Sept. 19th, Judge Hazel, sitting in the U. S. Circuit Court for the Southern District of New York, handed down a decision favorable to the Wagner Electric Manufacturing Company in a suit in equity of the Arnold Monophase Electric Company, complainant, against the Wagner Electric Manufacturing Company and Herbert A. Wagner, defendants, involving the title to United States Letters Patent Nos. 543,836 and 562,365. In reference to this case Mr. W. A. Layman, general manager of the Wagner Company, says: "Some years ago certain Philadelphia parties enjoyed an option to purchase the above patents. On the expiration of this option, the Wagner Company acquired the patents, and proceeded to the development of a commercial line of apparatus thereunder. When it became evident that the Wagner Company's product was a commercial success, the Philadelphia parties organized the complainant company above, for the purpose of attacking the Wagner Company's title to the patents. This litigation has been going through the Courts for some time. Judge Hazel's decision sustains the Wagner Company fully and completely in their title to the patents. The patents in question are those of Prof. E. Arnold and constitute a part of the chain of patents involved in the single phase power motors manufactured by the Wagner Company."

INJURY TO EMPLOYEES.—The Court of Appeals of Maryland, in the suit of Ziehn versus the United Electric Light & Power Company, of Baltimore, has reversed the decision against the plaitiff in the lower court, and ordered a new trial. The points of the decision are as follows: (1) A verdict can be directed only where the facts are undisputed or where but one reasonable inference can be drawn therefrom. (2) Where defendant electric light and power company maintained certain high-tension wires near the distributing pole of a telephone company which the latter's employees were required to climb, defendant owed such employees a legal duty to have its wires so placed and insulated as to permit them to perform their work in safety. (3) In an action for injuries to plaintiff, a telephone lineman, by coming in contact with a defectively insulated electric light wire negligently permitted to remain near a telephone pole, he was required to ascend, whether plaintiff was guilty of contributory negligence, *held* for the jury. (4) In an action for injuries to plaintiff by coming in contact with a defectively insulated electric light wire negligently strung near a telephone pole, evidence that defendant after the accident changed the location of its wires was inadmissible. (5) In an action for injuries to plaintiff by coming in contact with a defectively insulated electric light wire, evidence as to the insulation of other wires than those in use by defendant was properly disallowed.

ACCIDENT TO TELEPHONE LINEMAN.—The Court of Errors and Appeals of New Jersey has reversed the judgment for the defendant in the suit of Snyder versus the New York & New Jersey Telephone Company. The syllabus by the Court of the decision is as follows: (1) Plaintiff was employed by the defendant company to string some of its wires above and across certain electric light wires of another company. There was evidence, if believed, that the electric light wires did not usually carry any current, except at night, and that this fact was known to plaintiff. Shortly before plaintiff's injury the defendant company received notice from the electric light company that it would thereafter send through its wires in the daytime a current of dangerous intensity. Plaintiff testified that this fact was not communicated to him. Held, that there was a question for the jury whether the failure of the defendant company to give plaintiff notice was a breach of its duty to him. (2) There being evidence that the plaintiff had observed that the electric light wires did

not customarily carry any current in the daytime, and further evidence that on Saturday plaintiff and others, to facilitate their raising the telephone wires, took down the electric light wires, and at the close of the day replaced them, finding no dangerous current passing, and that on Monday they manipulated some of the telephone wires, so as to justify an inference that they came in contact with the electric wires, without indicating any dangerous current therein, and that plaintiff, while working on the last of the telephone wires, received a serious injury from the current of electricity of intensity greater than that applied to telephone wires. Held, that there was a question for the jury whether the risk was an obvious one to the plaintiff, and that a nonsuit was erroneous.

Educational.

INTERNATIONAL CORRESPONDENCE SCHOOLS.—The fifteenth anniversary of the founding of the International Correspondence Schools will be celebrated at Scranton, Oct. 16.

PUBLIC LECTURE COURSES.—The New York Board of Education is resuming its admirable course of public free lectures under Dr. H. M. Leipziger. In response to the demand for instruction in electricity, six courses have been arranged, so that all sections of the city will be provided for. W. W. Ker, of the Hebrew Technical Institute, will lecture at public school No. 165, on 108th Street and Amsterdam Avenue, on "The Principles and Practice of Electrical Engineering," on Saturdays, and on the same evenings Theodore I. Jones will give a series of talks on "Telephone Engineering" at St. Bartholomew's Lyceum Hall on East 42d Street. At Judson Memorial Hall on Tuesdays Prof. C. L. Harrington will give a course on "Electricity and Magnetism." Lectures will be provided in five of the new Carnegie libraries and the buildings will be kept open after the lectures so that the auditors may get books for home reading on the subject of the evening. In all of the public library branches of the city books pertaining to the lectures at nearby centers will be listed. During the first months of the season no less than twelve new centers will be opened.

Obituary.

MR. J. H. FOSTER—The death is announced at Evansville, Ind., of Mr. James H. Foster, sixty-two years old, secretary-treasurer of the Gas and Electric Light Company, a brother of Col. John W. Foster, ex-Secretary of State and uncle of Congressman Foster. His health had been failing for some time. Mr. Foster was a graduate of Indiana University, class '68, prominent socially and a leading Republican.

MR. KARL G. GILBERG, a prominent Swedish engineer in this country, has succumbed to a severe attack of typhoid fever at Indianapolis while on a business visit to that city. He was a member of the firm of Gilberg & Hamilton, electrical and mechanical engineers, of New York City. He left, a short time ago, for Indianapolis to take charge of the repairs and reconstruction of the public water works. He was a member of the American Society of Swedish Engineers, the American Institute of Electrical Engineers, and the local lodge of the Knights of Pythias. He leaves a mother and sister. His younger brother succumbed a year ago to the same disease.

Personal.

MR. JAMES MACKIN, formerly connected with the Peoples Gas and Electric Company, of Oswego, N. Y., has become a partner with Mr. John H. Snyder in the Oswego Electric Supply and Construction Company.

MR. S. C. HARVEY, manager of the Bowling Green exchange of the Central Union Telephone Company, has resigned to accept a position with F. B. Cook, of Chicago, who manufactures a safety appliance for telephones.

MR. R. S. LEBEAUX has become the successor of Mr. A. F. Wilson in the New York office of the Marshall Electric Manufacturing Company, and the latter gentleman has gone with the Manhattan Electrical Supply Company, of this city.

MR. CHARLES A. BARTOW, superintendent of equipment of the Worcester Consolidated Street Railway, has resigned to become superintendent of motive power for the Rio Janeiro Street Railway, Light & Power Company, of Rio Janeiro, Brazil, of which company Mr. Frederick A. Huntress, formerly of Worcester, is general manager. Mr. Bartow has been connected with the Worcester company twelve years.

MR. LOUIS BLOCK, 49 East 42d Street, New York City, will practice at his offices there as a consulting engineer, the scope of his work including specifications and plans for power plants, oil and gas engines, and ice manufacturing or refrigerating plants, as well as construction examination, testing, etc., of such plants. He was 24 years with the De La Vergne Company, and for two decades at the head of its engineering department.

PROF. A. M. MOREHOUSE.—Special advices from Ann Arbor, Mich., state that "Prof. A. M. Morehouse of the department of electrical engineering is going to London in the interest of the Western Electric Company of Chicago. He is to study the telephone industry in Great Britain and report on it. He also is to act as the Chicago company's official adviser to the British post office bureau. The firm plans to install its Pupin loading coils in the offices."

MR. A. P. H. SAUL, who has been general foreman of the power houses for the Pennsylvania Railroad in Olean, N. Y., for the past two years, has accepted the position as assistant general sales agent of the Robertson Electric Company, of Buffalo, and has assumed his new duties. The employees of the power houses presented him on leaving with a watch fob, on which is mounted a gold signet pendant engraved "A.P. H. S. 1906" as a token of their esteem.

MR. F. C. FINKLE has resigned his position as chief engineer of the Edison Electric Company, of Los Angeles, the resignation to take effect January 1st. Mr. Finkle plans to devote his time to consulting engineering work and will have an office in Los Angeles. He will be retained as consulting engineer by the Edison Electric Company. He has already been retained as a consulting engineer by Curtis & Hine, of Colorado Springs, in connection with some of their important Colorado projects. Mr. Finkle has been chief engineer for the Edison Electric Company for a number of years and has been largely instrumental in the design and construction of its seven hydro-electric plants in Southern California.

MR. C. B. MAHAFFEY, who has been engineer at the Denver office of the General Electric Company for five years, has resigned, to take effect Oct. 1, in order to accept a position as electrical engineer with Curtis & Hine, of Colorado Springs. Mr. Mahaffey began his work with the General Electric Company in 1898 at Schenectady, N. Y., and his varied experience in the Western states will make him a valuable acquisition to Curtis & Hine, who are already managers of several important power plants and have now in hand the development of some very extensive hydro-electric projects in Colorado and Mexico.

MR. GEORGE W. WOOD, of Syracuse, N. Y., the superintendent of construction, has been promoted to the position of construction engineer of the Central New York and the Empire State Telephone and Telegraph companies. Mr. Wood is a native of Utica, and since making Syracuse his headquarters has gained a wide acquaintance. His father, F. G. Wood, of Utica, is secretary and treasurer of the company. Mr. Wood has held many responsible positions with the Central New York Company. While superintendent of construction he built 2,500 miles of toll lines and nearly fifty exchanges, employing a force of a thousand men.

MR. L. B. STILLWELL has just taken a contract to reorganize and complete the power station of the United Railways & Electric Company, of Baltimore. The work will be along the same lines as those undertaken by Mr. Stillwell several years ago for the Niagara Falls power plant, viz., the completion of the construction of the power plant and the organization and training of an operating force for its proper operation. This is a specialty of Mr. Stillwell, who considers the organization and training of a competent operating force a very essential part of power plant work. In Baltimore he has undertaken to accomplish this task in a year. On Oct. 1 Mr. Horatio A. Foster, the well-known consulting and mechanical engineer of Philadelphia, became associated with Mr. Stillwell, and has now moved his office to Baltimore, where he will become resident engineer in charge of this work in an office recently opened in the Continental Building in that city. Mr. Foster is well known as the author of "Foster's Handbook of Electrical Engineering." He is particularly expert in the valuation of electric properties.

PROF. D. C. JACKSON.—The Massachusetts Institute of Technology is to have a new head of the electrical engineering department in Professor Dugald Caleb Jackson of the University of Wisconsin. This vacancy, which has been held temporarily by Professor Clifford, was caused by the resignation of Professor Louis Duncan two years ago. Professor Jackson was born in Kennet Square, Penn., in 1865. In 1885 he graduated from the Pennsylvania State College and went to Cornell for a two years' graduate course in electrical engineering. For two years he was vice-president of the Western Engineering Company of Lincoln, Neb., and then became affiliated with the Edison interests as assistant chief engineer of the Sprague Electric Railway and Motor Company. Later he became chief engineer of the central district of the Edison General Electric Company. During this period he designed, built and operated many of the largest electric railway and lighting plants and is now advising engineer for several large corporations. He was a member of the international jury of the World's Columbian Exposition in 1893, and of the Association of Scientists at the Pan-American Exposition in 1901, and is the author of many well-known books and papers.

News of the Trade.

KEOUGH ELECTRIC COMPANY, of 41 North Street, Boston, succeed to the business of Keough Bros. & Co. The new company will be carried on as electrical contractors by Augustus and James E. Keough.

STANLEY-G. I.—Mr. W. R. Hendrey, the manager of the Seattle office of the Stanley-G. I. Electric Mfg. Company has removed his office from the Pioneer Building, that city, to 410 Colman Building.

Trade Publications.

ATLAS ENGINE WORKS.—The Atlas Engine Works, of Indianapolis, have issued a little treatise on Atlas four-valve medium speed engine. It is of technical interest to our readers and copies will be sent on application to any address.

GREGORY ELECTRIC COMPANY, corner Sixteenth and Lincoln Streets, Chicago, has issued a very attractive bargain sheet for September, comprising a large variety of apparatus at prices that ought to go far to clean out the works.

GENERAL ELECTRIC COMPANY has issued with flexible cover a small size catalogue No. 3463, devoted to its miscellaneous G. E. specialties in lamp sockets and receptacles, attaching plugs, switches, cutouts, fuses and general wiring appliances. This is accompanied by a price list in the same binder. The catalogue section, giving data in brief, runs 212 pages.

PRINGLE ELECTRICAL MANUFACTURING COMPANY, of 1906-8 North Sixth Street, Philadelphia, has just issued another edition of its catalogue, which proves a very handy book for desk and pocket use. It gives illustrations and prices on all the goods that the company makes in knife switches, switch boards, etc., and serves its purpose admirably. Copies can be had on application.

WRIGHT DEMAND INDICATOR.—The Stanley-G. I. Electric Mfg. Company, Pittsfield, Mass., has issued bulletin No. 604, devoted to the Wright demand indicator which records the maximum amperes for either direct or alternating current circuits. This device is well known to our readers. An indication of its value to electric lighting men will be obtained when it is learned that a single lighting company obtained 10,000 indicators on one order.

ALLEN BLOTTER SERIES.—L. B. Allen & Co., Chicago, now have three very pretty series of blotting pads—the "International," "College Girl," and "Famous Paintings." They are distributing these through the mails to the jobbing houses and to prospective customers and will be glad to discuss the matter with jobbers who are interested in this kind of advertising, in connection with the Allen soldering stick, soldering paste, soldering salts, liquid flux and commutator lubricant.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out to the trade a catalogue of condulets and is calling attention to the fact that it is carrying a complete stock of all styles and sizes up to and including the 1-inch. Condulets have been on the market for only a comparatively short time, but have already made a place for themselves and are becoming extremely popular among contractors and wiremen. It is suggested that anyone who has not received a copy, write the Central Electric Company, 264-270 Fifth Avenue, Chicago.

WATER WHEEL GOVERNORS.—Bulletin No. 106 of the Lombard Governor Company, Ashland, Mass., gives an illustrated description of Type Q vertical type governor. This governor is built in two sizes designed for developing 6,700 ft.-lbs. and 10,000 ft.-lbs. respectively. Bulletin No. 107 of the same company deals with types B and D governors, which are of the horizontal type. It is stated that there are at the present time more of these machines in use for accurate speed regulation of water-wheels than of all other kinds of governors combined.

FRANK H. STEWART CATALOGUES.—Frank H. Stewart Electric Company, 35 North Seventh Street, Philadelphia, make the important announcement that they have gone into the fixture business very extensively, and now claims to be in a position to give unusually efficient service in that field. It has just issued a large and full catalogue devoted entirely to that line of work, the size of page being 15 by 10½ in., thus permitting the display of a number of handsome electroliers, fixtures, etc. Several pages are also devoted to detail devices and appliances. This is No. 12 catalogue. It has been followed by No. 13 devoted exclusively to electric automobile supplies. This is a quarto of 26 pages.

BALL ENGINE ANNIVERSARY.—The Ball Engine Company, to celebrate the fact that it is "25 years young," as already noted in these pages, has issued a very handsome and tasteful little brochure in folder form, giving the story of its work for a quarter of a century in building high speed steam engines, many types of which have been designed specially for work in the electric lighting field. That fact alone has determined the high quality of the product, for nowhere else is such close regulation required. The company is building to-day both automatic and Corliss engines, embodying the experience, inventions and improvements of 25 years, and many of these details are noted and illustrated in the pamphlet. A handsome illuminated cover enwraps the pages of text and the works at Erie, Pa., are shown in a frontispiece.

SINGLE-PHASE INDUCTION MOTORS.—A complete line of single-phase induction motors is described in bulletin No. 4455 recently issued by the General Electric Company, Schenectady, N. Y. The primary windings are similar to those of a three-phase motor. For purpose of giving to the motor a torque at starting a displaced voltage point is obtained at the intersection of a resistance and a reactance connected in series across the supply mains. Some of the motors are fitted with three primary terminals, while others have six terminals. In the case of motors provided with six leads, the winding connections are changed through a controller from "star" at starting to "delta" while running. By this arrangement a starting torque of approximately 150 per cent. is obtained with 200 per cent of full-load current. These machines are built in sizes rated at from .25 hp to 15 hp.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia. Next meeting, New York City, October, 1906.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, 12 West 31st St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Meeting, Birmingham, Ala., Oct. 2-5, 1906.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, 60 Wall St., New York. Next convention, Columbus, Ohio, Oct. 15-20, 1906.

Association of Edison Illuminating Companies. Secretary, Geo. R. Stetson, New Bedford, Mass.

Association of Railway Telegraph Superintendents. Secretary, P W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

Association of Electric Lighting Engineers of New England. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, T. S. Young, Toronto Ont.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November, 1906.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electric Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 1, 1906.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can. Next annual meeting, January 14, 1907.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, T. R. Beal. Poughkeepsie, N. Y. Annual meeting, October, 1906.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot. 4 Irving Place, New York. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Lawrence, Kan., Oct., 1906.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Oct. 16, 1906.

Missouri Independent Telephone Association. Secretary, James F. Barnett.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, 1907.

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglir, Philadelphia, Pa.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y.

Northwestern Electrical Association. Secretary, B. C. Adams, Madison, Wis.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, O.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, F. W. Bullard, Cleveland, O.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, O.

Old Time Telegraphers and Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Washington, D. C., Oct. 9, 10 and 11, 1906.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 25, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

831,530. TROLLEY POLE CONTROLLER; James F. Boggs, Needles, Cal. App. filed Sept. 21, 1905. A trolley pole is hinged to a horizontally positioned pneumatic cylinder, and has a link connection with the piston thereof. In case of too great vertical movement air is automatically admited to lower the pole.

831,548. JOINT FOR ELECTRIC CONDUCTORS AND OTHER WIRES. Austin Fleeger, Chicora, Pa. App. filed Aug. 18, 1905. The ends of the wires to be joined are pushed into orifices in a tubular box containing pebbles or irregular bodies of chilled iron or hard material, and these pebbles co-operate with inclined walls of the box to bite the conductors and prevent their withdrawal.

831,562. INSULATED TRACK SYSTEM; Andrew Morrison, Pittsburg, Pa. App. filed June 9, 1905. Adapted for metallic ties. The rails are separated from the ties by a rubber pad and secured by bolts having an insulating bushing.

831,599. INDUCTIVE SYSTEM; Ralph C. Browne, Salem, Mass. App. filed Aug. 19, 1904. Relates to a form of magnetic circuit changer by which the terminals of a storage battery are automatically connected for charge and discharge.

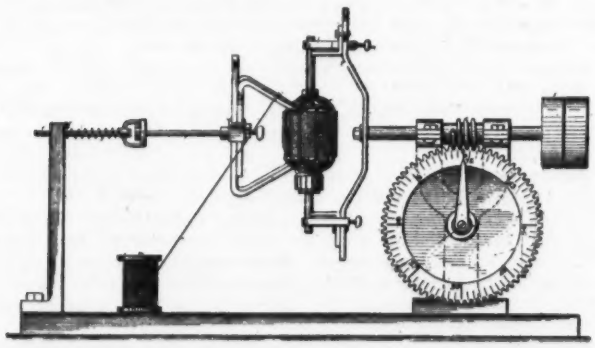
831,609. ELECTRICAL MEASURING INSTRUMENT; Carl Hering, Philadelphia, Pa. App. filed Aug. 3, 1905.

831,624. ELECTRIC RAILROAD; Jeremiah Murphy, Chicago, Ill. App. filed Feb. 9, 1906. The third rail is made with an inverted U-shaped groove on its under side and a roller on a horizontal axis runs in said groove and constitutes the collector shoe.

831,625. VENTILATED ARMATURE; James F. McElroy, Albany, N. Y. App. filed Apr. 18, 1905. The armature laminations are collected into groups and the separate groups are separated for ventilation by special laminated plates having lateral embossed lugs thereon.

831,634. ALARM SYSTEM APPARATUS; Richard F. Spamer, Chicago, Ill. App. filed Sept. 23, 1905. Provides a clock driven mechanism for automatically sending in a trouble signal to alarm headquarters when a local circuit is tampered with and giving an O K signal when the disturbing influence is removed.

831,666. ELECTRIC PANEL BOARD; Montgomery H. Johnson, Utica, N. Y. App. filed July 8, 1905. The panel board has metallic plates positioned on posts at a slight elevation above its surface and these plates are stamped to form threaded shells for its plugs or thermal cut-outs as desired.



831,740.—Armature Winding Machine.

831,687. SELECTING AND SIGNALING SYSTEM; Robert J. Sheehy, New York, N. Y. App. filed Oct. 9, 1902. A printing telegraph system for railroad and municipal installations has means by which the central operator may select and connect his apparatus with any one of several instruments in the circuit.

831,724. METHOD OF FIXING INCANDESCENT LAMPS; Josef Levin, Munich, Germany. App. filed Nov. 16, 1905. A device for preventing the fixtures of incandescent lamps being unscrewed when the lamps are removed. Has an internal nut on the threaded extension of the supporting tube.

831,740. ARMATURE WINDING MACHINE; Paul E. Oswald, Los Angeles, Cal. App. filed Oct. 23, 1905. A specially formed chuck is adapted to receive the armature and the tail spindle; has a U-shaped fixture which guides the wire into the proper groove of the armature when the live spindle is turned.

831,776. RAIL BOND; Fred H. Daniels, Worcester, Mass. App. filed June 8, 1903. The bond is made of copper laminations or ribbons and copper blocks are machined to form a recess to receive said ribbons and afterward the blocks and ribbons are welded into homogeneous union.

831,815. CONNECTOR FOR ELECTRICAL CONDUCTORS; Paul F. Williams, Chicago, Ill. App. filed May 23, 1905. A connection adapted for joining the ends of cables without requiring a wiped joint. Provides a pair of separable members of insulating material, means for confining the conductors therein, and an insulating compound for sealing the conductors.

831,819. TELEPHONE SYSTEM; Francis G. Bell, London, England. App. filed Oct. 9, 1905.

831,821. ILLUMINATING DEVICE; Alfred W. Beuttell, London, England. App. filed Oct. 17, 1902.

831,830. RAIL BOND; John P. Clark, Ypsilanti, Mich. App. filed May 27, 1905. In order to avoid the solder of a rail bond from cracking off in use, the patentee has a woven wire shell surrounding the bond into which the solder is fused.

831,843. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF ZINC; Victor Engelhardt, Vienna, Austria-Hungary. App. filed Sept. 14, 1904.

831,548.—Joint for Electric Conductors and other Wires.

831,846. AUTOMATIC TELEPHONE SYSTEM; John Erickson, Chicago, Ill. App. filed Dec. 30, 1904.

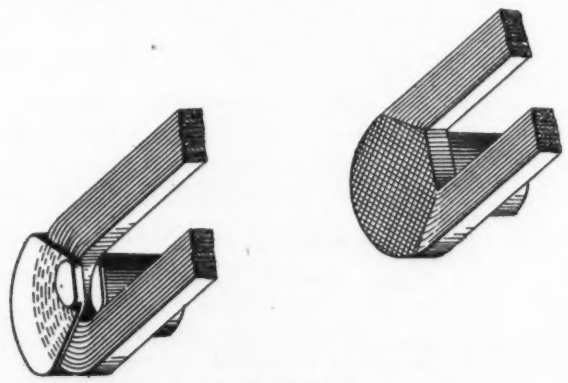
831,847. ELECTROTHERMAL SWITCH; John Erickson, Chicago, Ill. App. filed Dec. 31, 1904. A thermal cut-out having two spring blades, one of which is tipped with a toller and which engage one another to make electric contact. When the thermal element expands the blades are displaced sufficiently to separate. May be repositioned when the thermal element cools.

831,848. ADJUSTABLE HARMONIC RINGER FOR SELECTIVE SIGNALING SYSTEMS; John Erickson, Chicago, Ill. App. filed Sept. 18, 1905. The vibrator of an ordinary telephone bell is made so that its period of vibration is adjustable to any desired periodicity.

831,855. TELEPHONE TRANSMITTER-ARM; Harry J. Guttman, Chicago, Ill. App. filed Nov. 25, 1905.

831,875. INTERRUPTER FOR AUTOMATIC TELEPHONE OR OTHER SWITCHES; Alexander E. Keith, Chicago, Ill. App. filed Feb. 17, 1905.

831,876. SWITCHING OR TELEPHONE SYSTEM; Alexander E. Keith, Chicago, Ill. App. filed Mar. 9, 1905.



831,776.—Rail Bond.

831,889. TELEPHONE ATTACHMENT; William A. Patterson, Pittsburg, Pa. App. filed Oct. 20, 1905.

831,911. INDICATOR; Chester Versteeg, Ashton, S. D. App. filed Feb. 10, 1906. A device for indicating when the grain in a grain bin falls below a certain level. A normally displaced vane is impelled by a spring to close an alarm circuit when the pressure of the grain is removed.

831,930. MOTOR OR ENGINE; Charles C. Clark, Corning, N. Y. App. filed Sept. 13, 1905. A compressed air locomotive has electric means for running when the compressed air supply is low.

831,959. AUTOMATIC ELECTRIC SWITCH, PARTICULARLY FOR USE IN CHARGING ELECTRIC ACCUMULATORS; Henry Leitner, Woking, Richard N. Lucas, Byfleet, and Harry Hill, Woking, Eng. App. filed Feb. 10, 1905. Makes use of a constantly energized shunt circuit in connection with series windings for a cut-out switch.

831,968. SELF-TESTING SAFETY CODE; Charles J. Mitchell, Toronto, Can. App. filed Oct. 9, 1905. The code words used by any firm have the usual arbitrary meanings assigned, and in addition the words are so chosen that certain prearranged letters, as for example, the first, third and ninth letters of the words, give a check on the price or some factor of the message in order to test its accuracy.

832,024. PROCESS FOR THE ELECTRODEPOSITION OF METALS; Josef A. Nussbaum, Charlottenburg, Germany. App. filed Nov. 28, 1905.